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TRANSACTIONS

OF THE

Fifteenth International Congress on Hygiene and Demography

WASHINGTON
September 23-28, 1912

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Hygiene of Occupations

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SECTION IV.

HYGIENE OF OCCUPATIONS.

REPORT OF THE SECRETARY.

Dr. George M. Kober, *President Section IV*,
Fifteenth International Congress on Hygiene and Demography.

Sir: In accordance with the provisions of Article XII of the regulations of the congress, I herewith submit a report of the proceedings of Section IV during the meeting held at Washington, September 23 to 28, 1912, together with such manuscripts of the papers read as have been delivered into my hands.

MONDAY, SEPTEMBER 23, 1912—4.15 P. M.

The first session was called to order by the president, Dr. George M. Kober, who announced the following honorary presidents of Section IV:

Sir Thomas Oliver (England), Prof. Dr. L. von Frankl-Hochwart (Austria), Sir Arthur Whitelegge (England), Dr. L. Teleky (Austria), Dr. L. Carozzi (Italy), M. Henri Mamy (France), Miss Margaret McMillan (England), Prof. Dr. Wilhelm Lindemann (Germany), Prof. Dr. Theodor Weyl (Germany), Prof. Tadahiro Noda (Japan).

An introductory address on The Hygiene of Occupation was given by the president.

Papers were presented in the symposium on the physiology and pathology of work and fatigue as follows:

The Effects of Temperature and Humidity on Fatigue, by Prof. Frederic S. Lee, Columbia University, College of Physicians and Surgeons, New York City.

Fatigue Factors in Certain Occupations, by Prof. Shepherd I. Franz, George Washington University, Washington, D. C.

The Study of Fatigue and its Application to Industrial Workers, by Miss Josephine Goldmark, National Consumers' League, New York City.

The Fatigue Neuroses, by Prof. Wm. A. White, George Washington University, Washington, D. C.

Deleterious Effect of Unnecessary Noise, by Dr. Clarence John Blake, professor of otology, Harvard Medical School, Boston.

Existing Legal Provisions with Regard to the Suppression of Unnecessary Noises, by Mr. Stoughton Bell, Boston, Mass.

The subject of unnecessary noises was discussed by Prof. James J. Putnam, of Harvard University.

Stimmhygiene, Ihre Bedeutung und Ihre Organisation in Preussen (Deutschland), von Prof. Dr. Th. S. Flatau, Leiter der phonetischen Abteilung bei der Kgl. Universitäts Ohren- und Nasenklinik, Berlin, Germany.

TUESDAY, SEPTEMBER 24, 1912—9.15 A. M.

President Kober presided during the morning session.

In the symposium on occupation neuroses the following papers were presented:

Die Beschäftigungsneurosen, by Prof. Dr. L. v. Frankl-Hochwart, Vienna, Austria.

What Occupation Neuroses Really Are, by Dr. Tom A. Williams, Washington, D. C.

An Unusual Form of Mineral Poisoning (Manganese?) Affecting the Nervous System, by Dr. Louis Casamajor, New York City.

Eye Strain and Occupational Disease, by Dr. George M. Gould, Atlantic City.

A New Therapeutic Agent in Ophthalmology, by Dr. C. G. Precerutti, head physician of the ophthalmological section of the Cottolengo Hospital and head consulting physician at the Ophthalmic Hospital of St. Joachim, of Turin.

A symposium on the physiology and pathology of work in compressed air followed:

An unsuspected Cause of Caisson Disease, by T. Kennard Thomson, vice president, American Society of Mechanical Engineers, New York City.

Die Gefahren der Caissonarbeit, von Dr. Philipp Silberstern, k. k. Polizei-Ober-Bezirksarzt, Wien.

The Acute Effects of Caisson Disease, by Dr. Seward Erdman, instructor in clinical surgery, Cornell University, Medical College, New York City.

The Remote Effects of Caisson Disease, by Dr. Peter Bassoe, Rush Medical College, Chicago.

The Prevention of Caisson Disease, by Henry Japp, member Am. Soc. C. E., New York City.

The following members of the congress joined in the discussion:

Sir Thomas Oliver, England; Dr. Andrew Harvey, Chicago; Dr. L. de Pulligny, Paris; Henry Copley Greene, Boston; Dr. Charles H. Crankshaw, Newark; Dr. Julius Grinker, Chicago.

TUESDAY, SEPTEMBER 24, 1912—2 P. M.

President Kober and Honorary President von Frankl-Hochwart presided.

A paper on the Exposure of the Organism to Intense Heat was presented by Surg. Charles N. Fiske, United States Navy, Washington, D. C.

In the symposium on diseases and accidents caused by electricity the following papers were presented:

Injuries Caused by Electricity, by Sir Thomas Oliver, Newcastle upon Tyne, England.

Diseases and Injuries Occurring in Electric Generating Plants, by Dr. J. D. McGowan, Chicago, Ill.

Die Unfälle und Erkrankungen der Eisenarbeiter, von Prof. Dr. Röpke, Solingen.

Accidents par Électrocution, by M. Paul Weiss, chief mining engineer of Paris, Ministry of Public Works, Paris, France.

In the symposium on diseases and accidents of miners and tunnel workers the following papers were read:

Ueber die Unglücksfälle und Berufskrankheiten der Minen- und Tunnelarbeiter, von Dr. Wilhelm Lindemann, Bochum, Germany.

Diseases and Accidents of Miners and Tunnel Workers in the United States, by Dr. Joseph A. Holmes, Director, United States Bureau of Mines, Washington, D. C.

These papers were discussed by Dr. R. M. Cunningham, Alabama.

WEDNESDAY, SEPTEMBER 25, 1912—9.15 A. M.

President Kober, Honorary President Sir Thomas Oliver, and Vice President Frederick L. Hoffman presided at the morning meeting.

Papers were presented in the symposium on occupational diseases as follows:

The Incidence of Industrial Anthrax in Liverpool, by Dr. E. W. Hope, medical officer of health, city and port of Liverpool, and professor of hygiene, Liverpool University; and Dr. W. Hanna, assistant medical officer.

The Economic Aspects of Hookworm Disease in Porto Rico, by Dr. Bailey K. Ashford, United States Army, San Juan, P. R.

The Economic Aspects of Hookworm Disease in the United States, by Prof. C. W. Stiles, United States Public Health Service, Washington, D. C.

Occupational Brass Poisoning—Brass Founder's Ague, Dr. Emery R. Hayhurst, College of Medicine of the University of Illinois, Chicago.

Industrial Mercurial Poisoning in Felt-Hat Makers, by Frank E. Tylecote, M. D., D. P. H., M. R. C. P., honorary physician to the Salford Royal Hospital, Manchester, England, visiting physician to the South Manchester Union hospitals.

Die Gefahren in dem Gebrauche des Quecksilbers in der Industrie, von Dr. Karl Heucke. Königl. Gewerberat, Wesel, Rhein.

L'Hydrargyrisme dans les Couperies de Poils, par le Dr. D. J. Glibert, Inspecteur Général du Travail à Bruxelles.

Industrial Plumbism, Dr. Alice Hamilton, Hull House, Chicago; Sir Thomas Oliver, Newcastle upon Tyne, England; Dr. Francis D. Patterson, Philadelphia.

Occupational Diseases in New York. by W. Gilman Thompson, M. D., New York City.

Legal Protection for Workers in Dangerous Trades in the United States, John B. Andrews, secretary. American Association for Labor Legislation, New York City.

The following members of the congress joined in the discussion:

Dr. Wickliffe Rose, Washington, D. C.; Dr. Claude A. Smith, Atlanta; Dr. Bailey K. Ashford, United States Army, San Juan, P. R.; Mr. Edgar T. Davies, Chicago.

THURSDAY, SEPTEMBER 26, 1912—9.15 A. M.

President Kober and Honorary President Sir Thomas Oliver presided.

Papers were presented in the symposium on the medical examination of employees as follows:

Occupational Diseases and Physical Examination of Workers, by Dr. George M. Price, director of investigation, New York State Factory Investigating Commission, New York City.

Examination of Employees for Tuberculosis, by Dr. Theodore B. Sachs, Chicago.

The Results of a Hygienic and Sanitary Inquiry into the Italian Printing Trade; A Hygienic and Sanitary Inquiry in Silk Mills, by Prof. L. Carozzi, Milan, Italy.

The American Museum of Safety, its Organization, Objects, and the Three Departments of Accident Prevention, Industrial Hygiene, and Mutuality, by Wm. H. Tolman, director American Museum of Safety, New York City.

Die ständige Ausstellung für Arbeiterwohlfahrt in Charlottenburg. (Anstalt des Deutschen Reichs.) Von dem technischen Leiter der Ausstellung, Dr. Konrad Hartmann, Berlin-Grunewald.

In the symposium on the protection and welfare of workers papers were read as follows:

The Sanitary Control of an Industry by the Industry Itself, by Miss Lillian Wald, head resident nurse, Henry Street Settlement, New York City.

Industrial Insurance, the Basis of Industrial Hygiene, by Dr. Lee K. Frankel, Metropolitan Life Insurance Co., New York City.

The following members of the congress joined in the discussion of these papers:

Miss Margaret McMillan, London; Dr. Ernest D. Easton, Newark; Dr. George M. Price, New York City; Dr. Charles W. Crankshaw, Newark; Dr. I. M. Rubinow, Washington, D. C.

THURSDAY, SEPTEMBER 26, 1912—2 P. M.

President Kober and Vice President Dr. Wm. C. Hanson of Boston presided.

Papers were presented in the symposium on governmental study of occupational hygiene as follows:

The Hygiene of Occupation and its Administrative Control, by Dr. Wm. C. Hanson, assistant to the secretary, Massachusetts State Board of Health, Boston.

The Prevention of Occupational Diseases in Massachusetts, by Dr. H. Linenthal, State inspector of health, Boston, Mass.

Prevention of Occupational Diseases in Japan, by Medizinalrat Dr. med. Tadahiro Noda, Tokyo.

The Relation of the United States Bureau of Labor to Industrial Hygiene, by Charles H. Verrill, of the United States Bureau of Labor.

State Commissions on Occupational Diseases, by Prof. Charles R. Henderson, University of Chicago.

State Commissions on Occupational Diseases, by Prof. John R. Commons, University of Wisconsin, Madison.

In the symposium on sex problems in industrial hygiene papers were read as follows:

Effects of Industrial Strain upon the Health of Working Women, by Dr. Rosalie Slaughter Morton, New York City.

Infant Mortality in Relation to Factory Labor, by Dr. George Reid, medical officer of health, Staffordshire, England, and Dr. John Robertson, medical officer, Birmingham, England.

In the symposium on age problems in industrial hygiene the following papers were read:

Altersprobleme gewerblicher Hygiene, von Dr. Ludwig Teleky, Wien, Austria.

The Labor and Work of Children Should be Adapted to the Individual Child, by Thomas Morgan Rotch, M. D., Boston.

These papers were discussed by Edward T. Davies, Springfield.

It was moved and seconded that the resolutions introduced by Sir Thomas Oliver and Dr. William C. Hanson be approved and forwarded to the president of the Permanent International Commission, Dr. Max Rubner, with the request that they be approved by the commission.

The resolution proposed by Sir Thomas Oliver is as follows:

Resolved, That for the important object of securing the highest degree of practical utility in the notification, tabulation, and analysis of the official returns of occupational diseases it is recommended that such notification and returns should be made in a uniform manner by international agreement.

Resolved further, That such nations and States which do not as yet provide for a compulsory notification of occupational diseases are earnestly urged to do so at the earliest opportunity.

The resolution proposed by Dr. William C. Hanson is as follows:

Resolved, That all physiological and pathological studies of occupational diseases be conducted by persons who, in addition to a medical education, possess a practical knowledge of sanitary science with special reference to the hygiene of occupations.

Resolved further, That in the prevention of occupational diseases the subject of factory sanitation be supplemented by measures providing for general education in personal and occupational hygiene, and in the improvement of the housing conditions, food, and community life of the employees.

FRIDAY, SEPTEMBER 27, 1912—9.15 A. M.

President Kober and Honorary President Sir Thomas Oliver presided.

The following papers were read:

The Effects of Monotonous Toil in the Years Preceding Adolescence, by Miss Margaret McMillan, member of school board, London, England.

Child Labor in the United States, by Owen R. Lovejoy, New York City.

Tenement-house Manufacture, the Causes, Evils, and Remedy, by Dr. Annie Sturges Daniel, New York City.

The following papers on the problem of the smoke nuisance in industrial cities were presented:

How and Why Smoke is Injurious, by Prof. Raymond C. Benner, department of industrial research, University of Pittsburgh.

The Influences of Heavy Smoke on Acute and Chronic Lung Infections, by Dr. Wm. Charles White, associate professor of medicine, University of Pittsburgh.

A Psychosis following Carbon Monoxide Poisoning, with Complete Recovery, by Dr. Mary O'Malley, senior assistant physician, Government Hospital for the Insane, Washington, D. C.

FRIDAY, SEPTEMBER 27, 1912—2 P. M.

A joint session of Sections IV and IX. The session was called to order by Prof. Walter F. Willcox, the president of Section IX.

The following papers were presented:

Industrial Accidents and Trade Diseases in the United States, by Frederick L. Hoffman, LL. D., Statistician, Prudential Insurance Co., Newark, N. J.

Reporting of Industrial Accidents, by Prof. Robert E. Chaddock, Columbia University, New York City.

Demography of Industries and Occupations, by M. Lucien March, Director of the General Statistics of France, Paris.

Mortality from Alcohol in the United States, by Edward Bunnell Phelps, Editor, the American Underwriter, New York City.

Respectfully submitted.

Alice Hamilton, M. D.,
Secretary of Section IV.

MONDAY AFTERNOON, SEPTEMBER 23, 1912.

THE HYGIENE OF OCCUPATIONS.

Introductory address by GEORGE M. KOBER, M. D., LL. D., professor of hygiene, Georgetown University, Washington, D. C., president of Section IV.

Health is the chief asset of the workingman, and no greater calamity can befall him than when his earning capacity is impaired or arrested by reason of sickness or disability. It means, in many instances, the utter financial ruin of the family, and is doubtless one of the most potent causes of poverty and distress.

Many of the diseases are incident to occupation and environments, and industrial efficiency and earning power can be promoted by appropriate safeguard and adequate protection of the men, women, and children engaged in gainful occupations.

In the search for the causes and prevention of diseases, the interests of the wage earners have not been neglected; indeed, it may be truly said that a special department of social medicine has been created, with a most complete and satisfactory literature relating to the hygiene of occupations and the prevention of occupational diseases and accidents.

German authors in 1897 issued a volume of over 1,200 pages, and English authors, under the editorship of Sir Thomas Oliver, devoted 891 pages to "Dangerous trades, the historical, social, and legal aspects of industrial occupations as affecting health."

A pioneer study was made by Prof. Ramazzini, of Padua, as early as 1700, and his monograph was translated into English in 1705, and also into French, in 1777.

In 1810, the French Government issued a decree relating to "establissements dangereaux, insalubres et incommodes" and, in 1815, the English Parliament appointed a commission to inquire into the condition of factories.

In 1822, Mr. C. Turner Thackrah, of Leeds, wrote a monograph on the "Effects of the arts, trades, and professions, and of civic states and habits of living, on health and longevity" and, in 1845, Halford, of Germany, published a very important work on occupational diseases.

In 1833 and 1865 the English Parliament again appointed commissioners, and, in 1839, the "Academie des Sciences Morales et Politiques de France" and, subsequently, Bavaria, Prussia, and the German Empire directed similar investigations.

As a result of these efforts and of numerous independent investigations it is known to-day that persons habitually engaged in hard work, especially in factories and indoors, present a greater amount of sickness and a higher mortality than persons more favorably situated, and that the character of the occupation to a great extent influences, not only the average expectation of life, but also the prevalence of certain diseases.

It is known, for example, that bronchitis, pneumonia, and tuberculosis are much more frequent in dust-inhaling occupations, and that the sharp angular particles of iron and stone dust, and mixed animal and vegetable dust, are more liable to produce injury of the respiratory passages than coal, flour, grain, and some other forms of dust.

It is also known that workers in lead, mercury, phosphorus, poisonous dyes, and toxic or irritating fumes suffer especially from the injurious effects, and that other occupations, such as mining, railroading, and those which necessitate working with or around moving machinery, involve especial danger to life and limb.

For these reasons, workers in many industries need special protection, and in order to render this efficient, it must be provided for by the enactment and enforcement of suitable laws. In 1833, 1864, and 1870, England enacted the so-called factory laws. France provided a child-labor law in 1841, and, in 1874, a more satisfactory labor code. Germany and other continental governments enacted suitable legislation between 1859 and 1886.

According to Miss S. S. Whittelsey's "Essay on Massachusetts labor legislation" child labor received attention in that State as early as 1836. The first law as regards safety and sanitation was enacted in Massachusetts in 1877, since which time 42 States have enacted laws providing for the reporting of industrial accidents in factories, mines, and railroads.

Occupational diseases have been shamefully neglected, and it is only within the last two years, 1911 and 1912, that California, Connecticut, Illinois, Maryland, Michigan, New Jersey, New York, and Wisconsin have followed the lead of Massachusetts, and enacted laws requiring physicians to report occupational diseases, including anthrax, compressed air or caisson disease, and poisoning from lead, phosphorus, arsenic, and mercury, or their compounds.

Forty-eight States now have laws designed to provide for the installation of safety devices for the prevention of industrial accidents from moving machinery.

Dr. Andrews reports that regulations for protection against injurious dust have been enacted in 22 States, against defective or improper lighting in 12 States, against poisonous gases, fumes, and vapors in 15 States, against excessive temperature and humidity in 11 States, for the protection of workers in compressed air in 1 State only (New York).

Thanks to the efforts of the National Association for Labor Legislation, Congress, after two years of investigation, by an act approved April 9, 1912, prohibits the manufacture of poisonous phosphorus matches in the United States after July 1, 1913.

Thirteen States have workmen's compensation or accident insurance laws, all of which were enacted during the last two years.

No provision, however, has yet been made in the United States for insurance against occupational diseases. Industrial diseases and accidents are everywhere assuming more and more importance, not only to wage earners, but to all who are interested in the conditions under which our fellow men and women live and work, and our knowledge should be based upon accurate data. In countries and States where reports of certain occupational diseases are compulsory it is quite possible to secure reliable data as to the number of cases of industrial poisoning. The same may be said of the facilities afforded by the statistics of the German industrial insurance institutes, which furnish not only the number of deaths, but also the number of cases treated, together with the age period and duration of the disease. Similar facts should be collected in this country. This is all the more important when it is remembered that, even with the most complete statistics, it is extremely difficult to determine all the factors which influence the health and longevity of operatives. Great differences are found in the conditions under which the work is performed, some of which are entirely avoidable, while others are not; and it is hardly fair to characterize certain trades as dangerous, when experience has shown that no harm results when proper safeguards have been taken.

In the consideration of this question the personal element of the workmen, their habits, mode of life, food, home environments, and so forth, can not be ignored. There are a number of occupations in which the alcohol habit prevails to an unusual extent, perhaps because of the character of the work, perhaps as a result of association, and it would not be fair to attribute the ill health of the operatives altogether to the character of the employment. Again, many persons are engaged in occupations for which they are not physically fitted, while others ruin their health by vice, dissipation, improper food, and insanitary environments. In addition to all this, there are factors, such as water and soil pollution, for which neither the industry nor the individual is primarily to blame. Thus, for example, the general anæmia and debility of the agricultural classes in Porto Rico was attributed some years ago to their occupation and starvation, when, as a matter of fact, Ashford demonstrated that it was caused by the hookworm disease and spread by soil pollution. Similar investigations have shown that much of the ill health among the textile workers in the South is due to hookworm infection, and can be eradicated by the administration of thymol and the construction of sanitary privies to prevent soil pollution. All this indicates the need of a thorough study of the condition affecting health in various occupations, not only to determine the relative health risks and the causes of the undue prevalence of certain diseases in certain occupations, but also to formulate rules which may remove the causes or render the system better fitted to resist them. In this, as in all preventive efforts, a hearty cooperation of the parties interested is absolutely essential for the attainment of the highest measure of success. In this instance the responsibility rests with the State, the employer, and employee; each have certain duties to perform, and the help of all is necessary for the mitigation of existing evils.

We can not enter into details of the industrial diseases, except to say that among the occupations usually classed as inimical to health are bleachers, bookbinders, brass founders, compositors, coppersmiths, electrotypers, stonecutters, gas-work employees, white-lead workers, potters, match workers, mirror makers and workers in mercury, persons employed in the manufacture of explosives, firemen, file makers, rubber, factory, and textile operatives.

Sir Thomas Oliver, in his address on "Dust and fumes, foes of industrial life," will point out the human and economic aspect of the work in which we are engaged. It is certainly startling to be told by Mr. Fredk. L. Hoffman, in his monograph on "Mortality from consumption in dusty trades," that the general death rate for 1900 in manufacturing and mechanical industries of the United States was 13.8 per 1,000 and the consumption rate 2.6, or 18.8 per cent, of the mortality from all causes, while the farming population furnished a consumption rate of only 1.5, or 9.5 per cent, of the mortality from all causes. Indeed, it is estimated that nearly 70,000 wage earners perish every year from industrial tuberculosis, and that by factory inspection and effective methods for the prevention and removal of dust fully one-half of these lives could be saved.

This is not at all speculative, since Prof. Röpke informs us that, as a result of general education and factory sanitation, the mortality at Solingen, in Germany, the population of which is largely made up of employees in the cutlery industry, has been reduced from 20.63 per 1,000 in 1885 to 9.3 per 1,000 in 1910, and the consumption death rate from 540 in 1885 to 180 in 1910, per 100,000 of population. Similar data are available to show that diseases of the respiratory organs in one of the German cement works has been reduced from

9.3 per cent to 3.3 per cent after the installation of a suitable apparatus for the removal of dust.

What can be done in some of the most dangerous industries in Germany can be done in this country, and will be done as soon as the importance of the subject is fully appreciated.

Apart from the terrific waste of human life from occupational diseases consider, if you please, that there were, according to Prof. Star, 3,500 deaths in 1910 from industrial accidents in the United States. In addition to this there are an average of 3,000 killed and over 6,000 injured in the coal mines. "The total number of railroad casualties for the year ending June 30, 1911, was 160,555 (10,396 killed and 150,159 injured); of this number, 439 killed and 79,237 injured are classed under the head of "industrial accidents," which did not involve the movement of cars or engines on rails."[1]

What an excess of pain and sorrow, what an ocean of blood and tears, are contained in these figures. And alas, what an amount of ignorance and neglect when we compare our statistics with those of other countries and learn that the average number of men killed for each 1,000 men employed in coal mining in our own country, in 1909, was 4; in Prussia, 2.06; in Great Britain, 1.28; in Belgium, 1; and in France, 0.91. Is it not fair to assume that these figures clearly indicate that we have been derelict in efforts to safeguard the lives and limbs of our working classes? After almost fifteen years of agitation Congress finally created a Bureau of Mines a little over one year ago, and there is much reason for assuming that, under the humane and intelligent efforts of the chief and his accomplished staff, beneficent results may be expected.

Let us remember that over one-third of our population is engaged in industry and that we have just begun to realize what a tremendous and unnecessary toll death has been exacting in many of our industries. It is to be hoped that the deliberations of this section will serve to prevent this needless sacrifice of life and health. In the language of the New York Factory Investigating Commission:

> The State not only possesses the power and the right, but is it charged with the sacred duty of seeing that the worker is properly safeguarded in case of fire, that he is protected from accidents caused by neglect or indifference, that proper precautions are taken to prevent poisoning by the materials and processes of his industry, and that he works under conditions conducive to good health and not such as breed disease.

While I am a strong believer that the hygiene of occupations is largely a public-health function, and should be under the supervision of Federal and State health authorities, it is possible that the creation of departments of labor and health will result in a closer cooperation and coordination of the efforts for the conservation of human life and happiness than any other method of administration heretofore proposed for the solution of this important problem.

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THE EFFECTS OF TEMPERATURE AND HUMIDITY ON FATIGUE.

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The physiologist in his fondness for investigating internal mechanisms is prone to overlook the important fact that the living body exists in the midst of a multitude of external conditions. These conditions furnish stimuli to the living tissues, augmenting or diminishing their actions, and such stimuli play an important part in determining the activities and correlations of the internal mechanisms. The organism as a whole in the midst of its environmental conditions must establish for itself at each successive moment a balance in the work of its various parts. If one of the conditions is altered this balance is by so much disturbed. Within limits, and even within wide limits for brief periods, such a disturbance is borne with impunity: a readjustment to the altered situation occurs; a new balance is struck; and no harm results. But if the limits be much or long surpassed the normal adaptation gives place to a pathological state which is detrimental to the organism.

Of the two environmental conditions here in question, the temperature and the humidity of the air, there exists a certain medium range of variation within which the human body is capable of performing its best work. Even when adapted to this optimum it may be subjected for a considerable period of time to a high temperature or a low temperature, to a high humidity or a low humidity, without serious disturbance of its organic balance. One need not be a man of science to realize this truth; one needs not to live outside of our own America, famed for its fitful climate. But prolonged exposure to extremes of these conditions does not conduce to the continuance of a normal physiological state. The effects of a low temperature and a low humidity have not been studied as fully as have those of the opposite extremes, and these two latter have especial significance when they are associated with one another. I propose therefore to confine myself to a discussion of the physiological and pathological relations of the living body when subjected simultaneously to high temperature and high humidity.

We may observe these relations on many of the hot and humid summer days in our American cities. We may observe them when one who is adapted to a temperate climate goes to live in the Tropics.

They are well illustrated in various industrial occupations, such as mining, baking, laundering, and some varieties of cotton weaving. The effects of exposure to the atmosphere of these situations are many and various. The bodily mechanism for resisting external heat is at once brought into action. The blood vessels of the skin become dilated and charged with blood, the skin becomes heated, and the sweat glands become active. From the skin there occurs a loss of bodily heat by radiation, conduction, convection, and the evaporation of perspiration. The loss of heat by these processes, amounting, according to Rubner,[1] to 95.25 per cent of the total heat loss, may suffice for a time to keep the bodily temperature at its normal level. In proportion, however, as the temperature of the air approaches or surpasses that of the body and the humidity of the air is sufficient to prevent the evaporation of sweat, loss of bodily heat by the customary channels becomes lessened. Without adequate means for eliminating the heat that is being constantly produced within, the internal temperature rises and a febrile condition results. Such a state is reached the sooner the more mechanical work is performed and the more heat is thereby produced. Its oncoming is favored also by a lack of movement in the air. With a continuance of the unfavorable environmental conditions a simple rise of internal temperature may pass into a higher fever characteristic of simple heat prostration, or a moderately severe heat stroke with a temperature up to 40.6° C. (105° F.), and finally into the hyperpyrexial or intense form of heat stroke, in which the bodily temperature has been known to rise to the phenomenal height of 47.6° C. (117.8° F.). That the elevation of bodily temperature is the result of an elevation of external temperature and humidity combined has been well shown by various British authorities,[2] whose information is drawn partly from laboratory experiments and partly from observations in mines and factories. Haldane[3] summarizes the results of his observations as follows:

> These experiments proved that in very warm air it is the temperature indicated by the wet-bulb thermometer (not the actual air temperature as shown by the dry-bulb thermometer, nor the amount of moisture in the air, nor the relative humidity) which determines the ill effects produced. With a wet-bulb temperature exceeding 88° to 90° [F.=31° to 32° C.] in fairly still air the body temperature begins to rise, even in the case of persons stripped to the waist and doing no work, and when once started this rise continues until symptoms of heat stroke arise, unless the person leaves the warm air. In the case of persons doing muscular work, the rise of body temperature is much more rapid and begins at a much lower wet-bulb temperature. It will, for instance, begin (in persons stripped to the waist) at a wet-bulb temperature of about 80° [F.=26.7° C.] in still air with moderately hard muscular work, so that hard and continuous work is impracticable at wet-bulb temperatures of over 80° in still air. There is no doubt that when ordinary clothes are worn serious rise of body temperature occurs at a still lower wet-bulb temperature. Soldiers march-

ing in uniform are, for instance, liable to heat stroke at wet-bulb temperatures of under 70° [F.=21° C.].

A second striking effect of a combined high temperature and high humidity is a disinclination or actual inability to perform active muscular work. Beginning as a mere inertness, accompanied by sleepiness, which may readily be resisted for a time, it may pass into a genuine condition of fatigue, and ultimately into the exhaustion of heat stroke. Haldane[4] says of the Cornish miners of tin and copper:

> They do not * * * seem to be able to do more than a limited amount of work. The leisureliness of all work in the mine is in very striking contrast to what may be observed in any ordinary English colliery of about the same depth.

Pembrey,[5] after studying the effects of warm moist temperatures upon himself, medical students, and soldiers, concludes:

> The results show definitely that a man is much less efficient in a warm moist atmosphere. * * * A man can do far more work with less fatigue at a low wet-bulb temperature than at a high one.

Pembrey and Collis,[6] in speaking of the physiological effects of the warm moist atmosphere of cotton weaving, say:

> The natural tendency is for the nervous system to become less active and for muscular work to be diminished. In a weaving shed, however, the machine sets the pace and the worker must neglect the dictates of his sensations, which are the natural guardians of his health and well-being. * * * It is not surprising, therefore, that at the end of a day's work many of the weavers complain that they have no energy left, have no great desire for food, and need only drink and rest.

Boycott[7] says of mining in hot moist air:

> My observations on miners * * * lead me to conclude that their power of doing work under these circumstances is quite small.

Cadman,[8] professor of mining in Birmingham University, and late H. M. inspector of mines, gives more detailed observations to the effect that from about 25° C. (77° F.) wet-bulb reading, exertion begins to be accompanied by depression, and disinclination to work increases rapidly with an increasing wet-bulb temperature. At 27.8° C. (82° F.) "if clothes be removed and maximum body surface exposed work can be done providing current of air is available." At 29.4° C. (85° F.) "only light work is possible"; and at 35° C. (95° F.) "work becomes impossible." Stapff[9] observed in the construction of the St. Gotthard tunnel that the laborers, working in an atmosphere often completely saturated with moisture and with a temperature rising at times beyond 30° C. (86° F.), as measured by the dry-bulb thermometer, experience not only great discomfort, but indifference, enervation, weariness, and exhaustion. These direct statements are supplemented by the testimony of many industrial workers and observers of industrial conditions to the effect that combined high temperature and high humidity cause not only bodily discomfort but lessened power of labor. All who have experienced such conditions can not fail to agree with such testimony.

But the lessened power of labor under such circumstances may be real or only apparent. The sensations of fatigue which are undoubtedly present may diminish the amount of labor performed; but sensations of fatigue are often misleading and do not necessarily signify the presence of the actual physical basis of fatigue. Unfortunately there seems to have been made no exact comparative studies of the actual amount of labor which the human body is capable of performing under these abnormal conditions. This is but one instance of a lamentable lack of exact information regarding the capabilities of the body under different environmental conditions. This lack can be supplied only when we have devised adequate methods of testing the working powers of the living individual. Patrizi [10] has indeed shown that human muscles when subjected to localized hot baths, as by the immersion of the arms in hot water, and then stimulated electrically, undergo early fatigue and rapid exhaustion. This result is in harmony with those of Gad and Heymans [11] and others, who find that the excised muscles of frogs become rapidly fatigued when warmed. From all the available evidence therefore it seems probable that the actual physical basis of fatigue is present in a body working in a hot and humid atmosphere. A more detailed analysis of the physical and chemical conditions of such a body confirms this conclusion and, I venture to think, throws considerable light upon this hitherto obscure subject.

When in a hot and humid atmosphere the blood vessels of the skin are dilated and overcharged with blood, the brain and spinal cord, among other organs, are rendered correspondingly anemic. This is sufficient of itself to account largely for the feeling of weariness, the indifference and apathy toward laboring that are then present. The changed bodily sensations and the general bodily discomfort may also tend toward the same end.[12] But if the stage of elevated bodily temperature be reached, the internal conditions are still more radically changed. A febrile state, especially when pronounced and long continued, affords unusually good chemical conditions for the oncoming of fatigue. One of the striking metabolic accompaniments of the fevers that result from bacterial invasion of the living body is an increased excretion of nitrogen, which is derived, as is inferred from the work of various investigators, from an increased destruction of the proteins of the tissues, probably due largely to the direct action of the higher temperature upon them. This abnormal destruction of proteins appears to occur not only in fevers of bacterial origin, but in the hyperthermy produced by hot baths and in other ways. Schleich,[13] Formanek,[14] Edsall,[15] and others have found this to be the case. It was long ago maintained that along with the increased destruction of proteins in fevers there is an incomplete oxidation of intermediate metabolic products. In this connection, it is interesting to recall that Mandel[16] finds purin bases to be increased and uric acid to be decreased in quantity in febrile urine. Furthermore, Geppert,[17] Minkowski,[18] and Kraus[19] argue from the diminished quantities of carbon dioxide in the blood and from other facts that there occurs an acid intoxication during fevers. Ammonia, indicating also the production of acids, is increased in output.[20] Acetone and even diacetic and oxybutyric acids have frequently been found in febrile urine.[21] While it is still in doubt whether these acetone bodies arise from destroyed proteins or from destroyed fats, the fact of their existence as intermediate metabolic products seems clear.

Whether analogous changes occur in the hyperthermy resulting from exposure to a hot and humid atmosphere has not yet been sufficiently investigated, but it seems altogether probable that in such cases there is at least a great disturbance of metabolism. The theory of auto-intoxication as the essential causative factor in insolation was first suggested by Vincent in 1888.[22] It was adopted by Van Gieson,[23] Levene,[24] and Lambert[25] in their investigations of sunstroke during the extraordinary occurrence of that disease in the city of New York in the summer of 1896. The symptoms of the disease suggest strongly the presence within the body of an acute poison. Levene found that the blood serum of two patients suffering from the disease, as well as the urine of convalescent patients, was acutely toxic to rabbits; and although he was unable to demonstrate any increased nitrogenous metabolism he came to the conclusion that the symptoms of sunstroke result from an auto-intoxication due to some kind of a pathological decomposition of tissue. Van Gieson described histological changes in the nerve cells of the brain and spinal cord which are closely similar to those produced by various poisons, such as other auto-intoxicants, bacterial toxines, alcohol, and lead. Analogous lesions have been observed in either insolation or artificial heating by Goldscheider and Flatau,[26] Marinesco,[27] and Amato.[28] Various investigators[29] have found that when the temperature of the body has been raised, either experimentally or in insolation, the alkalinity and coagulability of the blood may be diminished. Another fact of significance is the unusually early appearance of rigor mortis and decomposition after death from insolation,[30] which suggests that an acidity may have developed in the muscles. From these various observational and experimental data it may be inferred, if not with certainty at least with a high degree of probability, that the subjection of a body to an external temperature and humidity sufficient to raise the internal temperature to a pathological degree causes metabolic changes, the nature of which is not yet known but which interfere profoundly with the normal working of internal mechanisms.

Fatigue is a physical phenomenon, a lessened power of work, which has as its basis certain metabolic phenomena. The two chemical causes of fatigue have long been recognized as the diminution of substance that is essential to activity and the accumulation of metabolic products that are toxic or depressing to the tissues. Of these fatigue substances carbon dioxide and lactic acid appear to play a prominent rôle in the production of normal fatigue.[31] It is probable, as I have elsewhere maintained,[32] that these are but types of other metabolic substances which act similarly. This is seen most clearly in certain pathological conditions. It is well known that in diabetes, for example, there exists an acid intoxication conditioned by the presence in the blood and tissues of β-oxybutyric acid and other acetone bodies. I have been able to show that when β-oxybutyric acid, either free or as a salt, is administered by irrigation to a muscle, the muscle behaves as if it had been fatigued by exhaustive labor, and I have explained the well-known proneness to fatigue of an individual suffering from diabetes as due in considerable part to the direct action on the tissues of β-oxybutyric acid and perhaps other associated pathological fatigue substances. It is probable that a similar explanation will hold for inanition, the pernicious vomiting of pregnancy, and the various other instances of acid intoxication, all of which are characterized by marked fatiguability. What has been said of β-oxybutyric acid is equally true of indol, which likewise is depressing to muscle and the presence of which in abnormal quantities within the body is associated with a similar tendency to fatigue.[33] It has been maintained [34] that the inability to perform continued labor that is so pronounced in neurasthenia rests likewise upon analogous metabolic causes, the identity of which has not yet been established. I think it probable that future research will greatly extend our knowledge of the metabolic bases of fatigue. Especially do I look for such a rôle to the intermediate metabolic products which may be present in abnormally large quantities in various pathological states. Such a conception too appears to me to afford the most probable explanation of the fatigue that appears to be present when the individual is endeavoring to labor in an atmosphere at a high temperature and a high humidity. Here he has to contend not only with his normal fatigue substances, but with the pathological substances that result from the peculiar conditions of his labor.

But there is a further factor to be considered. More than a hundred years ago Alexander von Humboldt [35] observed that heat increases the action of various chemical substances on various forms of living substance, such as the heart and the motor nerves. This has since been studied in many ways by many investigators, such as Hermann,[36] Kronecker,[37] Luchsinger,[38] Lauder Brunton,[39] Richet,[40] and others, and it has become recognized as a general law that the temperature at which poisons act upon living substance is a factor, as in other chemical phenomena, in determining the degree of their action—at a higher temperature their action is more intense. There seems to be no reason why this law should not apply to the case under consideration. This suggestion has indeed been made for normal fatigue substances by Patrizi[41] to explain the ready fatiguability of human muscles submitted to localized hot baths. With even greater weight it can be applied to the human being laboring under the disadvantageous conditions of excessive temperature and excessive humidity. Normal and pathological fatigue substances are here present in solution in an overheated body. If they are toxic at normal degrees of temperature, their toxicity is more pronounced at higher degrees, and in proportion as mechanical work is performed and internal temperature rises, the more is working power lessened.

I may, therefore, summarize my thoughts as follows: When an individual is subjected to an atmosphere that is charged with an excessively high temperature and high humidity, his bodily temperature is raised, his working power becomes limited, and there is an early oncoming of fatigue. In addition to the normal fatigue substances there are present other substances, products of an abnormal metabolism, perhaps of increased protein disintegration, which likewise act as fatigue substances. Both the normal and the pathological fatigue substances act toxically to diminish the activity of the tissues, and such fatiguing action is rendered greater by reason of the abnormally high internal temperature that is present.

If these considerations, presented from a purely scientific standpoint, are worthy, their significance ought to be more than merely academic. Industrialism presents numerous instances in which human beings are obliged to labor under the conditions here outlined. Constant submission to these conditions is detrimental to the well-being of the individual and ultimately of the race. This is an unnecessary situation, which sooner or later is bound to be relieved. It is the duty of men of science not merely to discover the conditions under which men labor, not merely to show how an environment is detrimental, but to use their influence to make of labor a physiological rather than a pathological exercise.

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FATIGUE FACTORS IN CERTAIN TYPES OF OCCUPATIONS.

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Certain factors which have influenced the course of fatigue have, for certain simple types of work or occupations, been carefully investigated. Thus, the rapidity of the operation, the amount of force needed in its performance, and the effects of some external conditions, such as meteorological, have been the subjects of numerous researches. Most of the investigations have, however, been planned and performed with the view to the acquisition of facts which may help to elucidate certain purely scientific questions, such as the nature of fatigue, its location, whether central or peripheral or both, and the relations of the fatigue effects, as lessened mechanical work, to the mental noncomitants which are known as feelings of fatigue or soreness.

While the facts which have been accumulated are of value for the understanding of the elements affecting fatigue in any condition of work, they are not always directly applicable to the solution of the problems of fatigue in occupations. One of the reasons for this is that the experimental conditions have been too greatly simplified, and they do not tend to approach the actual conditions in the factory or workshop. The purely practical problems differ in many respects from those of the greatest scientific interest, and it is not to be wondered that the methods in the latter must have been simple. On the other hand, it must not be forgotten that, in as far as an occupation consists of a simple movement or operation, the results of the fundamental scientific investigations may be directly applied toward an understanding of the fatigue effects and conditions in the workroom as well as those in the laboratory.

It has sometimes been hastily assumed that the effects of fatigue are always to be noted in a reduction in the amount of mechanical work, as measured in foot-pounds or kilogram-meters, or in the number of movements or operations which can be performed in a certain amount of time. There is, however, another factor which in certain types of occupations is much more important than the quantity of work or its force. This is the accuracy of the operation. There are three factors on the motor side in every kind of occupation. These are (*a*) the quantity or the force of the work, (*b*) the number of pieces that can be made, or the rate, and (*c*) the accuracy or fitness of the manufactured article for the purposes for which it was intended. In all operations the time element is a kind of common factor, although in some the emphasis is placed upon the force or the quantity of the work, and in others there is a strain after accuracy as well as speed. Thus, in shoveling coal, it is important that the coal heaver take upon his shovel a certain amount of coal if there is to be a maximum amount of mechanical work performed in a given time. Similarly, in the hewing of a tree, the force must be great and must be expended at definite intervals in order to have the work accomplished in the shortest time. On the other hand, accuracy in handling the material is the essential in such operations as sewing, typewriting, metal stamping of certain kinds, and so forth. In the last-named occupations the amount of mechanical work in each operation is almost negligible, although the total for a day or hour may be considerable. In tree cutting and in coal shovelling, although the emphasis is placed upon the amount of mechanical work performed, accuracy is also demanded, for if the coal is not shovelled into the bucket or into the chute, energy is being expended without a corresponding performance of work desired, and if the axe, in tree cutting, is not accurately directed, the maximum amount of cut will not be attained. In sewing, although the emphasis may be placed upon the straightness or accuracy of the seams, it must not be forgotten that the handling of the cloth involves mechanical work in foot-pounds or kilogram-meters. In typewriting the amount of mechanical work performed in hitting one key may not exceed that of 50 grams by 15 millimeters, but when this movement is performed for several hours at the rate of about four movements a second, the total is very great.

Because most of the previously published investigations had been concerned with the relation of the speed and the amount of mechanical work that could be performed, it was planned to carry out a series of tests to determine the relation of accuracy of movement to speed. Three separate but interrelated problems suggested themselves as being open to a laboratory investigation. These were (1) the relation of the speed of performance to accuracy, (2) the relation of the extent of the movement to its accuracy, and (3) the effects of changing of speed upon the accuracy of performance. Regarding certain of these problems we have facts which indicate that the accuracy decreases as the speed is increased, although not in direct proportion (Woodworth), and that the accuracy is less when the movement is greater, but here also not in direct proportion to the extent of the movement (Fullerton and Cattell, Woodworth). When there is only one simple movement to be performed, even though this be performed many times, and the movement be of considerable extent, great accuracy can be attained and kept up for long periods. Observations have been recorded by Woodworth of four laborers who were hitting hand drills with small hammers which illustrate this point. In 4,000 movements there was only one error in hitting the head of the drill with the hammer. Since the movement of striking was about 1.5 meters in extent, this would indicate that there was a small average error in direction of about one-third of a degree, or approximately of 0.9 centimeter.

The present work was more complicated, as far as the movements were concerned, than previous work to make it comparable with the simpler, but not the simplest, occupations, in that five movements were to be made. A form was constructed as a target with five points. These points were arranged in the form of an irregular pentagon, with the distance between the first and second points of 50 millimeters, between the second and third 75 millimeters, between the third and fourth 100 millimeters, between the fourth and fifth 50 millimeters, and between the fifth and the starting point 100 millimeters. Instead of having the subject strike the apical points of the pentagon, circles of 5 millimeters diameter were used, so that the subject might have a margin of error in the movement, as operators have in their occupations. The subject was instructed to hit with a pencil point, and in time with a beating metronome, each of the five points in succession, and start again after having completed the round. Each experiment consisted in the hitting of each circle on the target 25 times, making a total of 125 hits. In these experiments eight subjects were used, and the rates were changed after every second target, so that in a test with 12 targets there were four targets at each of three speeds, 1 hit a second, 2 hits a second, and 3 hits a second. In another series four speeds were used, 1.5, 2, 2.5, and 3.5 hits a second, respectively, but the individual tests were kept at the same constant speed. In the first series there were available for computation the results of 72,000 hits, and in the second series the results of 25,000 hits. The present communication is a preliminary account of the results of this study.

In calculating the results not only were the actual misses counted, but the average error of the misses was also taken into account. For those misses which were within 5 millimeters of the circumference of the circle an error of 1 was charged, and errors beyond this were counted 2, 3, 4, and so on, according to their distances from the circle.

RESULTS IN SERIES A.

At the slowest speed, the number of errors, in accordance with the method of calculation adopted, was less than two at the beginning (first 625 hits). but the number gradually rose until, at the end of the series, it averaged nearly 60 per 100 hits. At the intermediate rates of 2 and 2.5 hits per second, the initial errors were about 21 and 36, respectively, and there was a gradual rise in the error moment until almost the end of the series, when the errors were, respectively, 88 and 94. At the quickest rate, the initial error was as high as the final error in the next lower speed, namely, 94, and there was also a gradual rise throughout the series, especially during the first half, until the final error was 187.

Since the results here presented for this test are those for only one subject, it is not surprising that the error curves for speeds 2 and 2.5 partly coincide, for the tests in these series were performed on different days, and there may have been a better physical condition, and consequently less original fatigue effect, before the beginning of that particular series. It was found, in fact, that the errors with speed 2.5 were less on the sixth, seventh, and eighth sets of tests (625 each).

The errors for speed 3.5 are interesting, for that speed was the highest with which this particular subject could carry out the program of hitting at the circles. After the first five sets, the errors reach a maximum and remain there throughout the remainder of the experiment. It is probable that if the test had been continued a longer time, the amount of the error would not have increased to any appreciable extent, for during the last tests the circles were scarcely hit at all, the hits falling about the circles, and at considerable distances from them. Probably the maximum error period had been reached previous to that of exhaustion, at which time the subject would not have been able to hit at the target circles.

A comparison of the curves [1] for the serial tests and those for equal intervals of time in these experiments is interesting, for it is seen how soon fatigue sets in with the higher speeds, and how slow the fatigue effect forms when the speed is such that even short periods of rest intervene between the individual movements. The full effect of fatigue for the greatest speed was found to come within 20 minutes, while with the intermediate speeds of 2 and 2.5, the errors at the end of 45 minutes were only about as large as those in the initial test at the highest speed.

RESULTS IN SERIES B.

In the second series of experiments, eight subjects were used on six different days, with alterations in the rates of hitting the targets. Two experiments with one speed were made, then another speed with two experiments, and a third speed with two experiments, and so forth. Here, instead of the rate being kept constant, as in the first series, there were twelve targets used, four at each of three speeds, 1, 2, and 3 hits a second, and each target having 125 hits. The combination of results from all subjects at the three different speeds show that, as in the first series, the inaccuracies at the slowest speed are insignificant, those at the middle speed are many times greater, and those at the high speed are more than proportionately greater than those of the medium speed. Since the number of movements in this series was not much greater than those considered in the first two tests of the first series (250 at each point of the curve for each subject, as compared with 625), there is not to be expected the same amount of rise in the curves, to indicate the fatigue effect. When the tests are combined by threes, we do find a distinct rise in all the curves, although not as much as in the corresponding two periods in series A. The decrease in the error in the last test with speed 3 is comparable with the results in series A, in which similar slight reductions in error were found toward the end of the experiments. These results are comparable with those found in other fatigue tests, in which it has been repeatedly noted that the end of a series, when known, has an apparently stimulating effect upon the subject. In this way I would account for the reductions in inaccuracies.

An examination of the individual records of errors in relation to the three speeds, regardless of the serial number of the test, is interesting, in that it shows great variations in error for the three speeds. Some subjects are accurate for slow speeds, but very inaccurate for the higher speeds; others are inaccurate at all speeds, although the errors increase greatly as the 3-a-second speed is assumed.

The errors for the individual dots are also important to note. The results show, in general, that the movement of least extent is, on the whole, much more accurate than that of greater extent. In the experiments of this series if there be omitted from consideration the return to the starting point, there is a direct correlation between the errors and the distance. The first point should probably be omitted from consideration, since it was apparent that all subjects, in performing the tests, made them in 3–2 rhythm, thus dividing the work into two parts, and returning to the starting point, as if a new test were being made. Probably we should count the errors as the differences between the error for the first point and those for the other four points. Were this done, we should have a marked correlation, but not a direct relation, between the distances, and also the order of the hits.

One other matter needs brief mention. This is the relation of changing speeds to errors. When the speed was increased from one per second to two or three per second, there was found an increase in error much greater than that found when the rate was kept constantly at the higher figure. It would appear as if this "speeding up" process had interfered with the rhythmical activity of the neuromuscular apparatus in such a way that the adjustment was not as good. This phenomenon, although here stated to be found when the rate was changed from the slowest to one of the higher speeds, was also found to be present when the rate was changed from the medium to the high speed. A slight difference was also noted when the high rate suddenly gave way to a slower rate, although, in this latter case, the variation in accuracy was not as noticeable as when there was a change from slow to fast.

The following conclusions appear to follow from the experiments so far performed:

1. Fatigue is evidenced by inaccuracies in movement, as well as by the lengthening of the time of movement and by a decreased performance of mechanical work.

2. With increased speed, error increases, but the error increase is much greater than that of speed.

3. In extended series of movements at high speed there is a tendency toward a lack of coordination, evidenced by great errors and a smooth curve.

4. The error, or fatigue effect, at slow speed, at the end of about 6,000 movements, is about the same as that at medium speed after about 500 movements, and that at medium speed, at the end of about 6,000 movements, about the same as that at high speed at the end of about 500 movements.

5. Changing the rate of movement increases the proportionate errors, making them greater than those when the speed is a constant, and decreasing the speed increases the proportionate errors, although not proportionately as much as when there is an increase in speed.

6. The inaccuracy in movement increases as the extent of the movement increases, but is not directly proportional.

The relation of these facts to certain types of occupations, and to the process known as speeding up, is almost obvious, but the direct application must be reserved for future and more extensive communications.

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[1] These were shown at the Congress sessions, but are not reproduced here.

THE STUDY OF FATIGUE AND ITS APPLICATION TO INDUSTRIAL WORKERS.

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I. IN THE SCIENTIFIC STUDY OF FATIGUE, THE ESSENTIALS ARE AGREED UPON.

To an audience of scientists and medical men the results of the modern study of fatigue need not be detailed. Whatever the disagreements on special points, such as precise localization of the fatigue of nerve tissue, the molecular storage of oxygen, and other similar problems, the essentials are agreed upon, and are, indeed, among the commonplaces of science.

This being so, what application can be made of this accumulated knowledge for the benefit of those most subject to the inroads of fatigue—the vast number of men, women, and children who form the industrial armies of the world, supplying men's needs and luxuries?

The existence of this congress, with its many sections and subdivisions, is a proof of the great diversity of lines along which science is advancing to seek the innumerable causes of human disease and misery.

II. FATIGUE AS A DANGER OF OCCUPATION HITHERTO NEGLECTED.

The object of this paper is to point out some aspects of scientific study hitherto neglected in the United States which may assist in combating that danger of occupation, which is more widespread than all others, because it affects the largest number of wage earners—not only those in the so-called dangerous occupations, but every worker, man, woman, or child who is strained beyond physiological limits by excessive labor.

Heretofore the scientifically well-known principles of fatigue have not been utilized in the protection of the workers just because they have been unknown to those persons who could have benefited most directly. To all these, in the main, the contributions of science on the subject have been unknown. To the scientist, on the other hand, the industrial world has been an undiscovered country. Even physicians and students of hygiene are to a large extent unacquainted with the vast speed, the complexity of processes, and the still intolerably long hours of labor to which industrial workers are subjected, especially in our country, where industrial development has been most swift.

III. SOME EXAMPLES OF OVERSTRAIN IN INDUSTRY.

From among the innumerable examples which might be quoted, I chose a few to illustrate how flagrantly some common industrial occupations—in themselves innocuous—are carried on in defiance of the most elementary physiologic laws.

Among workingmen the most striking examples of overwork are found in the continuous industries or in industries continuously carried on, whether or not technical reasons demand that the processes of work be uninterrupted. No recent revelations of working conditions have aroused such general condemnation as the prevalence of the 12-hour day and 7-day week in the steel mills.

The most recent Government investigation of the iron and steel industry in the United States shows[1] that, of the 172,671 employees whose hours of labor were reported in May, 1910, nearly one-half (42.58 per cent) were kept at work 72 hours a week or over—that is, at least 12 hours daily on six days of the week. Nearly a quarter of all the workers (20.59 per cent) were kept employed 84 or more hours in the week—that is, at least 12 hours each day, including Sundays. In the largest single department in the industry, the blast furnaces, 88 per cent of the 31,321 employees, engaged in both productive and general occupations, were regularly kept at work 7 days in the week.

Among wage-earning women, two occupations may be cited as examples of the intolerable conditions of work still habitual among us. The first of these is an occupation which women have followed from time immemorial—the work of the laundry, common to all civilized nations; the second is an occupation practically new to the girls and women of the last decade—the telephone service.

During the winter of 1912 an official investigation was made of motor laundries in New York City by the bureau of arbitration of the State department of labor. The three following schedules of "long weeks" were reported among others in the stenographic minutes of evidence, and, while they need not be regarded as typical, they show to what extremes the employment of women is carried in the absence of effective regulation:

Day of work.	Woman who has worked 2 years in laundries.	Woman who has worked 5 years in laundries.	Woman who has worked 11 years in laundries.
Monday	12 noon to 12 p. m.	12 noon to 12 p. m.	——— to 9 or 10 p. m. (latest 1 a. m.)
Tuesday	9 a. m. to 11.30 p.m.	9 a. m. to 11.30 p.m.	9 a. m. to 11 p. m.
Wednesday	9 a. m. to 9.30 p. m.	9 a. m. to 9 p. m.	9 a. m. to 8 p. m.
Thursday	9 a. m. to 7 p. m.	9 a.m. to 7 p.m.	9 a. m. to 7.30 p. m.
Friday	9 a. m. to 6.30 p. m.	9 a. m. to 6 p. m.	9 a.m. to 6 p.m.
Saturday			

Regarding the telephone service, and its strain upon the energies of telephone operators, we are fortunately not thrown upon surmise, but have expert testimony. It should be borne in mind that the simplest form of telephone connection requires 11 different processes to be performed in instant succession by the telephone operator; she works, for the most part, at the top notch of expectancy, making and severing connections with all the speed she may. The constant flashing of signal lights on the board in front of her and the buzzing sounds heard in her ears when impatient subscribers jerk their telephone hooks add to the strain of the work. Five years ago a Canadian royal commission intervened in a dispute between the Bell Telephone Company, of Toronto, and their girl employees. The commission called upon 26 prominent physicians and neurologists for evidence concerning the physical effects of the work. The most important points brought out were the following:

1. Work at the telephone switchboard is not only a severe strain on the special senses of hearing, sight, and touch, but particularly on the nervous organization of the operators. Many examples were cited of operators whose health had been seriously impaired by the work.

2. It was agreed that rest or relief periods of not less than 20 minutes after each two hours of work were essential to preserve operators from exhaustion.

3. The maximum number of hours per day deemed compatible with health was 7 hours, broken by the proper relief periods.

In glaring contrast to these carefully considered medical opinions stands the Government report on the telephone service in the United States.[2] Overtime work beyond even the 9 or 10 hour day, relief periods curtailed or granted only as favors, the very general requirement of much Sunday work without any other compensating holiday, overloading, or the imposition of calls per operator beyond the known "breaking point of efficiency"—all these avoidable hardships exist in greater or less degree throughout the country. In the enlightened city of Boston, for instance, in June, 1912, a strike of telephone operators was avoided, after much conference, only by conceding to them requirements still decidedly exceeding the minimum laid down 5 years earlier by the Canadian physicians. They obtained the promise of 15-minute reliefs after each 3 hours of work, and an 8-hour workday, not however, to go into effect until after the summer, when the service is most exhausting.

Besides work in laundries and in the telephone service, a general industrial usage may be pointed out which is common to almost all industries, and which contributes to the overwork of wage earners to a degree unsuspected by most persons. This is the system of overtime.

Overtime is an elastic term. In its most extreme form it lengthens the workday to 24 hours in one stretch. In less extreme degree, overtime is worked during the fall months until 8 or 9 or 10 o'clock each evening in factories which supply the Christmas market; in paper-box making; in the manufacture of innumerable articles of women's wear, from lace collars to Japanese kimonas; in leather and jewelry work; in making the cheaper and more lasting candies, and in many other occupations. In fact, overtime is an integral part of the workers' lives, persisting not only for days at a time but for weeks and months; not occasionally lengthening the day's work, but during a large part of the year straining health and endurance to the utmost.

Thus, in the recent Federal investigation of wage-earning women and children, agents of the Government reported the normal hours of work, in miscellaneous manufactures, as 55½ in New York, 56.4 in Chicago, 53.3 in Philadelphia, 53 in Baltimore. But the average duration of overtime of selected workers in those cities during 1907–8 was 17.3 weeks, or over four months, in New York; 13½ weeks, or more than three months, in Chicago; 16.6 weeks, or again over four months, in Philadelphia; and 13 weeks in Baltimore.[3] In one printing establishment in New York City girls were employed overtime once and sometimes twice a week during a period of 16 to 26 weeks for 16¾, 20¼, 22½, and 24½ hours.

The essential injury of overtime is due to what has been graphically proved in the laboratory with the ergograph, because effort increases with fatigue, because work continued after fatigue has set in requires so much more subsequent time for recuperation. But during a "rush" or overtime season such time for recuperation is necessarily lacking. The girl who is kept in the great department stores until 11 or 12 or 1 o'clock at night during one or two frenzied weeks before Christmas, the girl who works at fever heat all evening stitching women's shirt waists in January for the spring trade, is not relieved from the necessity of reporting for work the next morning. She comes to work unrepaired, and with each day of overtime accumulated fatigue necessarily grows.

IV. TWO METHODS OF COMBATING INDUSTRIAL OVERSTRAIN—LEGISLATION AND EDUCATION OF EMPLOYERS.

These examples show how employments, in themselves innocuous, become unmistakably dangerous to health through the overfatigue and exhaustion they engender, and they are merely typical of countless other employments in which hundreds of thousands of girls and women are engaged. Fatigue is thus a danger of occupation as truly as any of the industrial poisons, and it must be recognized as such if it is to be combated.

It is precisely here that the aid of science is so urgently needed and has hitherto been almost wholly lacking. The most hopeful methods of combating overfatigue and exhaustion in industry are two: Legislation prohibiting excessive hours of labor and the education of employers. Neither method is sufficient alone. Legislation is still the cardinal need, since, after a century of experience, the factory codes of the most advanced industrial country must still be called the "minima of protection" for the workers. For the employer, too, who desires the best efficiency of his workers, such legislation is essential to protect him against the successful underbidding of unscrupulous competitors.

V. OBSTACLES TO LEGISLATION LIMITING THE WORKDAY.

Legislation limiting the workday to a specific number of hours (in only two of our States less than 10 hours per day) is, indeed, a crude gauge of working capacity. Yet, at the present time, it is the only available gauge, and the mechanism of enforcement, through improved factory inspection, must be perfected in this country before we shall be prepared to enforce more rational and more physiological limitations based on variations of work and of individual capacities.

So far are we still from a more accurate scientific gauge of working powers that 19 States have as yet no legal limitation whatsoever of woman's hours of labor. Among these are the great industrial States of North Carolina and South Carolina,[4] employing in manufacture, in the year 1910, respectively, over 21,000, and over 12,000 women, Georgia,[4] too, Alabama and Mississippi, each with thousands of women at work, have as yet failed to enact any laws protecting women from excessive hours of labor. These are all Southern States; farther north, too, progress has been so slow that, of 16 States which have enacted laws shortening women's hours of labor during the past two years, 7 States took such action for the first time, having never before the year 1911 afforded any such legislative protection whatsoever to adult women. These States were California, Kentucky, Maryland, Missouri, Ohio, Utah, and Wisconsin. Until the year 1912 the Empire State of New York, where nearly 300,000 women were employed in manufacture alone,[5] provided by law the inhumane 12-hour day, abandoned almost a century ago in British textile mills. To this day the great industrial State of Pennsylvania, third only to New York and Massachusetts in value of products, allows by law the 12-hour day for more than 168,000 women employed in manufacture.

Only 19 States protect women from excessive hours in the exhausting service of the modern department store, and conspicuous by their absence from this list are States with great commercial centers like New York, Ohio, and Rhode Island. Only 10 States[6] regulate by law the hours of women's work in the taxing employment of the telephone service and of these 10 six States still prescribe the 10-hour day, thus lagging behind the usage of the best companies.

So meager and so recent are even these crude measures of protection in our country, 38 years after Massachusetts enacted the first 10-hour law for women. It is, of course, true that in many of our States legislation has lagged because it has not been needed. In the last census less than 4,000 women were reported employed in manufacture in the whole mountain division comprising eight States: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada.

But, where protection is most acutely needed, where the great woman-employing textile and clothing trades are located, the opposition of powerful interests is met.

It is the cotton lobby which throws its great influence against the workers in the cotton States, the glass lobby in the glass States, the laundrymen's association, wherever legislation for laundry workers is proposed, the retail dealers' association, against any relief for shop girls. Individual employers, it goes without saying, are humane and enlightened, but their official organizations and representatives have won a sinister distinction in opposing labor legislation. Such associations of employers as those named above are found officially in the field at every session of the State legislatures. It was, for instance, the Illinois Manufacturers' Association which officially combated any restriction whatsoever of women's hours in Illinois, and failing to defeat the passage of the 10-hour law in 1909, bent all their energies, fortunately without success, to have the law annulled by the courts. It was the laundrymen's association which played the same part in Oregon in 1907, and even carried a case, also unsuccessfully, against the Oregon 10-hour law to the United States Supreme Court. It is the Retail Dry Goods Merchants' Association of New York City which, by fair means or foul, has succeeded in stifling all limitation of hours for adult women employed in department stores.

Now, it is precisely in opposing these powerful opponents, and in educating employers to a realization of true efficiency based on the physical fitness of their operatives, that the active support of scientific and medical men is essential for progress.

True, the scientific man is chary of ascribing to isolated and single causes such complex phenomena as the physical and nervous overstrain which is making itself manifest among working people throughout the world. The contributing and concomitant causes of underpayment, worry, bad living, and similar evils must be counted in any effort to appraise the strain of industry. Yet, two simple reasons exist for isolating the excessive duration of working hours, and for holding that duration to be the most important point of attack. The first reason is practical, because the excessive hours of labor can be curtailed and regulated by legislation, while better conditions within the home, better sanitation, nutrition, and hygiene can come only by slow process of education, as people are gradually taught to recognize such needs.

But there is a second and more fundamental reason for attacking the system of long hours. The shortened workday and relief from overstrain are not in themselves the cure for the ills which have been created, but they are the sine qua non, without which no other cure is possible or conceivable. Nothing can cure the exhausted worker and restore the buoyant resistance from which alone health and efficiency spring, which does not allow time for tissue repair and recuperation.

Yet with single notable exceptions, what effective or concerted action have physicians and scientists in the United States, either as individuals or in their associations, taken in regard to this simplest factor of the wage earners' lives, yet the one most fraught with possibilities of danger, the duration of their working hours? In America, until within the past few years, it has not even been recognized as a subject worthy of scientific interest or attention. The modern study of fatigue and normal metabolism has been hitherto almost wholly divorced from the world of industry and labor, a world far removed from the specialized lives of most physicians and scientific men. Yet it is precisely the wage earners who most need to have applied to them the scientific knowledge accumulated in the laboratories to preserve them from forms of labor now tolerated among us.

What we need is a new study of undue fatigue in industry. We need to have transferred into the factory and workshop, and to the telephone switchboard and the crowded department store, the kind of research which has yielded so rich a harvest in the laboratories. Both for a more rational organization of business and for intelligent legislation, we need definite knowledge of the effects of such industrial facts as those which we have briefly reviewed. We need to know, from systematic and continuous study, what are the actual results of speeding, and piecework, monotony and mechanical rhythms, and other incidents of industrial life. The workday is too long when it goes beyond physiological limits; in other words, when no adequate margin of rest is allowed for tissue repair. We need to know, for the various trades, and for the various operations in those trades, what is an adequate margin of rest. We need to know whether nervous diseases are on the increase among industrial workers in this country, as they are reported to be abroad by the statistics of the insurance societies. We need, above all, men of the highest caliber and professional standing to plan such investigations along broad inclusive lines, so as to discount what is transient and temporary, and to obtain the underlying facts, for the conservation of health and efficiency.

In the interests of efficiency many enlightened employers already provide medical supervision of the hygiene of their employees. These agencies could well be used for such systematic and continuous study as we have advocated. Once the importance of the subject is realized, once overstrain itself is recognized as a danger of occupation, study of overwork and its sequelæ must follow.

Another source of information on the effects of industrial overpressure has been hitherto unused. This is in the records of the clinics and hospitals where working people are treated. In this country we have not the opportunities afforded by the foreign insurance systems to study sick and convalescent wage earners. But from the thousands of working men and women to whom the hospitals minister yearly could we not learn those antecedent facts as to the strain of employment to which foreign insurance physicians have been forced to turn in the interests of prevention? The social service work established in connection with various hospitals, precisely for prevention, is a first step in this direction. The out-patient department in many hospitals follows patients into their homes in order to make sure that the benefits of hospital treatment are not immediately undone by unhygienic living. This work could well be supplemented by obtaining and keeping accurate records of the industrial as well as the medical history of patients. No better work for prevention could be done than by attempting to discover those elements in industry which contribute directly to the illnesses of thousands of workers and carry them, year by year, in throngs to the hospitals.

Through the nurses who visit patients in their homes and establish confidential relations with them the machinery for such an additional inquiry is available. The medical examination and record of patients at the hospitals give their physical histories in full. An invaluable additional body of information could be secured if detailed records were systematically kept during a series of years showing the previous trade history of patients, their previous hours of work, the length of overtime work at rush seasons, their night work, if any, the machinery or processes at which they were employed before illness, and many similar questions. These histories, to be accurate, would have to be corroborated by a separate industrial investigation of previous places of employment to confirm the workers' accounts of themselves. Such an investigation could be kept within manageable limits by confining it to the year or two years previous to the worker's illness.

The value of such an investigation would be cumulative if it could prove, after a series of years, by large numbers of individual and well-authenticated cases, the important part played by overstrain in the production of disease and ill health among wage earners.

Such case study of wage earners who have succumbed to illness has some advantages over the more general study of wage earners at work. What we seek to know is precisely what is implied in the Italian phrase, "the pathology of labor." Just as in medicine the study of pathology goes hand in hand with the study of physiology—

the morbid as well as the normal reactions often yielding most suggestive clues—so in industry not only the physiological but the pathological aspects must be scrutinized—the infectious diseases, anemias, nervous disorders, pelvic derangements in women, and the rest.

It is, in the last resort, those who succumb who must determine the dangerousness of any trade. Thus, for instance, many men no doubt can and do work in caissons without contracting the dreaded "bends." Yet the legislation which prescribes special rules of hygiene for caisson work is based on the victims, not the survivors. Hence it is essential to learn from a scientific observation of the victims of industry—possibly in hospitals and clinics, as suggested above—those unhealthful and dangerous processes of industry which lead to physical disorder.

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[1] Report on Conditions of Employment in the Iron and Steel Industry in the United States. Summary of wages and hours of labor, pp. 36 and 57. S. Doc. No. 110, 62d Cong., 1st sess., 1912.

[2] S. Doc. No. 380, 61st Cong., 2d sess., 1910.

[3] Report on Condition of Woman and Child Wage Earners in the United States, Vol. V, pp. 204, 208, 211, 213. S. Doc. No. 645. 61st Cong., 2d sess., 1910.

[4] South Carolina and Georgia have nominal 10-hour laws for factory employees, but these laws are nullified by their own wording.

[5] Thirteenth Census of the United States, 1910. Bulletin on Manufactures, p. 19.

[6] California, Illinois, Kentucky, Louisiana, Montana, Ohio, Oregon, Utah, Washington, and Wisconsin.

SOME CONSIDERATIONS REGARDING THE FACTOR OF FATIGUE WITH REFERENCE TO INDUSTRIAL CONDITIONS.

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Within the past few years a considerable literature has grown up with reference to the general subject of fatigue, and more recently it has been sought to utilize the results from the investigation of fatigue in helping to solve some of the industrial and occupational problems. While the mass of literature about these subjects is so large as to make any effort toward reviewing it at this time a practical impossibility, yet from it all there stand out certain general principles to which it is well worth while, upon an occasion of this sort, to call attention, while there are certain other fairly well accepted facts which belong within this same sphere but which have not yet received the recognition which is their due, to which attention also may be invited with some profit.

In the first place, the problem of fatigue has been most thoroughly worked over with reference to the subject of muscular fatigue and with the use of the nerve muscle apparatus. (Here the problem has been a relatively simple one, and yet, even with all its simplicity, there remain all sorts of questions to be answered, and the undisputed conclusions are few.) It is generally admitted, as a result of this kind of work, that fatigue has two factors—a negative and a positive, the former the result of an actual wearing out of the used substance, in this case muscle, and the second the result of the formation of certain poisonous substances, such as carbon dioxide, paralactic acid, and monopotassium phosphate. The term exhaustion has been very well proposed for this negative side of fatigue, while the word fatigue itself is used solely by some authors to indicate the positive side.

These results are results of the fatigue of muscle. The question of the fatigue of the nervous system is an entirely different one. As soon as an effort was made to define the actual place where fatigue occurred in the living animal, or the nerve-muscle apparatus, it was found to be no easy matter. In general, however, it may be said that the nerves themselves do not fatigue, and that the conception of the central nervous organs themselves showing fatigue, as is more particularly set forth by the experiments of Hodge, has changed materially of late years until it is now generally believed that the central nervous organs, like the nerves themselves, are little susceptible to fatigue. In the case of the nerve-muscle apparatus it would seem as if the nervous tissues were saved from fatigue by the fatigue of the muscle, or, more properly, both muscle and central nerve organs are saved from fatigue by fatigue of the motor end plates, in the same way that a dynamo may be saved from damage by the melting of a fuse. The classical experiment of Sherrington, which was to the effect that a muscle which is connected with a spinal-cord center, which center may be reached by several afferent tracks, responds as quickly to stimulation through one of these afferent tracks after one of the others has been so exhausted that no results follow stimulation, indicates that the locale of the exhaustion is at the synapse between the afferent and efferent neuron, and that, again, the central nervous organs are protected from exhaustion by this synaptic fatigue just as in the former case they were protected by the muscle fatigue. If these are the mechanisms, then it is readily seen that neither the central nervous system nor even the muscle itself can ever be seriously involved in fatigue; that the synpatic junctions and the motor end plates interpose obstacles to the occurrence of any serious disintegrating processes, and, therefore, are protective devices for conserving the organism.

MENTAL FATIGUE IS A STILL MORE COMPLEX PROBLEM.

We have no knowledge at all to-day of corollations between the symptoms of mental fatigue and any definite changes in the nervous system, and our means of measuring mental fatigue are, most of them, so complex when one comes to investigate them, and so contaminated by other than mental factors, that it is extremely difficult, in fact almost impossible, to evaluate the results. It is perfectly obvious, for example, that such instruments as the ergograph, the dynamometer, the æsthesiometer, and the algesiometer, all involve both mental and physical factors. When we come to take up the question of the symptoms of mental fatigue we realize that defect of attention is an important one of them. Then, when we realize that the whole attitude of psychology toward attention has been materially changing of recent years, and that attention is being more and more considered as an affective state, as an affective orientation of the individual as a whole toward a stimulus in the environment, the muscles naturally playing a very large part, it becomes evident that the difficulties are certainly very, very great.

At this point one can not resist drawing certain analogies. We have seen that it is fairly well conceded that the motor end plates and the synaptic junctions, by becoming impervious, prevent fatigue of the central nervous system; so it is a pretty generally accepted fact that, in the mental sphere, disorder of attention has the same conservative function. The person who can no longer pay attention is saved from the possibilities of serious fatigue, and this conclusion is in harmony with the more recent belief, *contra*, the original opinions following the experiments of Hodge, that the central nervous organs really do not suffer from fatigue.

In the face of these difficulties it would seem that we had better keep close to the fundamental principle of not mixing our categories, and so not endeavor to speak of fatigue in one category in terms of fatigue in the other. Let the mental and the physical, or, as symptoms, the psychic and the physiological, remain apart, and endeavor to determine questions of fatigue in the mental sphere purely by mental means. For this purpose probably the best method is Kraepelain's method of continuous additions.

This much I have said preliminarily, because questions of fatigue which arise in the consideration of industrial and occupational problems must almost invariably imply fatigue both of mind and of body. It will be seen, thus, that, in speaking of fatigue, we are still using a term of very vague connotations, and dealing with a condition that admits of measurement only with the greatest of difficulty. Not only this, but in the present state of our knowledge, it is practically impossible to state wherein the fatigue is resident, what part of the individual really is fatigued, and what are the mechanisms, both chemical and physical, of that fatigue. The general gross fact which seems to issue from this complex situation is that human beings, worked under given conditions, tend to show a gradual falling off in the efficiency of their work, and that this falling off in efficiency can be prevented by changing the conditions, more particularly, by increasing the opportunities for rest, and that, further, when human beings continue to work under conditions which show a gradual falling off in efficiency, other manifestations tend to come into evidence, namely, various kinds and descriptions of disturbances of health. So that, with our present knowledge, it would seem more accurate, and perhaps wiser, to deal with the human being as if he were a machine, and with his efficiency as measured by his output, and endeavor to find what the conditions are which lower his efficiency, either impairing it temporarily, or tending to impair it permanently, and then endeavoring to discover what the conditions are which will prevent this temporary or permanent impairment, and so increase the efficiency.

I have been tempted to say what I have said, which is more particularly a plea for greater definiteness in the use of terms, by looking through the literature of fatigue, particularly in connection with various occupations, and noticing with what little regard for accuracy the term *fatigue* and certain other terms were used. I refer more particularly to the conditions which are presumed to be the results of mental fatigue. I find numerous papers, some of them by well-known men, showing the prevalence and the increase, particularly of neurasthenia and hysteria, in certain occupations, and I note the statistics, particularly those of foreign sanitaria, for the working classes, showing the immense increase in nervous diseases that have been admitted to these sanitaria in recent years. There appears to be very little in any of this literature that at all adequately accounts for these conditions.

In the realm of the neuroses and the psychoneuroses, such, particularly, as neurasthenia and hysteria, to which my attention has been called, the particular character of the work, or its severity, could by no possibility operate, if our present ideas of these conditions are correct, as adequate causes. Hysteria, for example, is a purely mental disease, dependent upon purely mental causes; in other words, psychogenic in origin. Work of any character or description, or of any degree of severity, could not be conceived to be a cause in any true sense. We all know that if we have some weak point in our bodies that it bothers us more when we are below par, and we are able to adjust to it better when we are in good health. The muscles of accommodation, for example, partake of the tone of the general musculature, and when health is good they may give little trouble, but when the health is poor they may make difficulty. In the same way, and only in that way, can occupations or fatigue of any kind be said to be a causative factor of hysteria. They can only be adjuvant causes at best, and, at that, as you will see, unimportant ones.

With neurasthenia we are dealing with a condition which is not so prominently mental. In fact, neurasthenia, as we understand it to-day, is not a mental disorder primarily, but a physical disorder. However, the term "neurasthenia" is perhaps one of the most loosely used terms in medicine, and, as I see it through the literature that I have spoken of before, there appears to be no definiteness about its use. It is applied to all sorts and conditions of things, including the whole realm of the neuroses and the psychoneuroses, and probably some of the actual psychoses. Now we have a fairly well-defined syndrome to which the term neurasthenia is applicable, the symptoms of which are, in the main, a feeling of pressure on the top of the head, more or less insomnia, spinal irritation, with perhaps pain in the back, certain parathesias, easy fatiguibility, and emotional irritability. This may be a primary neurosis or it may be a secondary neurosis following upon other illnesses, such as prolonged sickness of some kind, or following an acute illness, such as typhoid fever. As a primary neurosis, it may be described as a primary fatigue neurosis, although it must be realized that the belief that it is due to fatigue, and that the symptoms are dependent upon the elaboration of toxic fatigue substances, is purely hypothetical. Even admitting the truth of all these things, however, there is absolutely no warrant, if our present concepts of this condition are correct, and they are being verified every day, for believing that occupation of any kind, or of any degree of severity, can be other than purely adjuvant and unimportant causes of this condition as in hysteria.

The limits of this paper prevent any extensive illustration of the opinions that I have just brought out with reference to hysteria and neurasthenia. Some of you will probably recognize that I have in mind the more recent hypotheses of Prof. Freud that would place both of these diseases, and a number of others, in the same category; namely, it would ascribe, as the necessary etiological moment in both cases, some sort of disturbance in the sex life of the individual, so that these diseases become of very greatest importance, not only because they are, as I have called them, social diseases, but their problems are essentially broader than the individual—they are biological problems. A single illustration will give you an idea of how I regard the situation:

We see in the literature, for example, that a great many of the telephone girls are getting neurasthenia and the cause is attributed to long hours of work, the extreme effort of attention that is necessary because of the character of the work, and its constant annoyance and irritating character. All of these things are true, but if the modern hypothesis of neurasthenia, to which I have referred, is correct they can not be the fundamental causes. To speak broadly, we can only understand the neurasthenia in such cases by thinking of these girls as individuals who have been prepared by nature, up to a certain point, to fulfill a certain function and then, because of the exigencies of life or what not, all of the energies which have been developed in that direction are, so to speak, sidetracked and at about the period of puberty, when nature might expect physiological and psychological fulfillment, the individual is called upon to make a complete readjustment, to find entirely new avenues of outlet of nervous energy, to concentrate upon entirely alien interests. Now some people are so constituted that they can do this thing, so they succeed. Others are so constituted that they can not. They become neurasthenic or develop other neuroses, while certain others, and they are perhaps the most frequent, occupy a borderland position. These girls, under favorable conditions of employment, with plenty of opportunity for rest, good food, good housing, and all that sort of thing, manage to get along. With prolonged hours of work and irritating conditions, perhaps coupled with unhygienic and insanitary living, they break down. So you will see what I mean by fundamental causes and how I regard the usually attributed causes as only adjuvant. You will see also why I believe the problem is deeper than the individual and strikes at once at the social conditions brought about by the various industries and occupations.

I might speak of other conditions, but these two are sufficiently illustrative. Hysteria surely, and in all probability neurasthenia, belong to the class of diseases which are not dependent upon the introduction or the action upon the body of some specific morbific agent. They are essentially social diseases which depend for their existence upon the maladjustment of the individual to his social surroundings, his inability to fit into the demands that are made upon him because of his relations to other people, actually or prospectively, and as such can not be dependent for their existence upon long hours of work or upon the character of that work. These considerations, however, do not make it any the less important that they be considered in connection with the various industries, nor does it make it obvious why there has been such an increase in the number of these diseases. A moment's reflection, however, I think will convince you if you accept my premises that their importance lies not in the fact of their association with any particular kind or character of work so far as the fatiguing qualities of that work may be concerned, but that they are expressions of causes that are much more widely operative, social causes which have invaded and changed the social conditions under which the people live, and evidently changed those conditions disadvantageously so as to make possible the outcrop of these diseases. The investigators of the industrial conditions should realize this factor in the situation as exemplified by the presence of this class of diseases.

My plea, then, in this paper is for the recognition of what I have termed "social diseases," for a realization that the problem of the various industries, as that problem deals with the question of the health of the workers, is a broader problem than the problem of ordinary physical disease. It is a problem which touches the whole question of society, and which presents for consideration the neuroses and the psychoneuroses as indications of a disease which is not individual, but social. Here we have in this class of diseases a point of attack upon abnormal social conditions, and, by their study, some kind of idea may be had as to the best means of approaching the faulty social conditions of which they are the expression, and which may be incident to the industrial conditions under consideration.

The necessary temporal restrictions of such a paper as this make it impossible for me to illustrate what I mean, except perhaps very briefly. It has been shown by careful analysis of certain cases of the psychoneuroses that the disorder was dependent upon experiences in the early years of childhood—types of experiences which, in many instances, were dependent upon the general crowded condition in which the family were forced to live. It will be seen, therefore, in such a case, that the disorder from which the patient suffers leads directly back to social conditions, which social conditions may or may not be dependent upon industrial conditions. The psychoneuroses, therefore, may become a very good barometer of certain social states dependent upon industrial conditions, and, while I am perfectly aware that the social state of the worker has been investigated very fully, still I do not think that it has been appreciated that many of the specific manifestations of illness are outward indications of certain types of social conditions that are undesirable. It will be seen, therefore, that a correllation between the work of the psychiatrist and neurologist, and the social worker, is possible along these lines. My paper merely bespeaks a recognition of the advantages of this correllation, which I am sure, if they were pursued, would be seen to offer many possibilities for work.

THE SUPPRESSION OF UNNECESSARY NOISE.

Clarence John Blake, M. D., professor of otology, Harvard University, Cambridge, Mass., president Ninth International Otological Congress.

That the question of the suppression of noise should have reached its present degree of public consideration is due both to an increase in the amount of noise incident to the development of the mechanical form of expression of human activities, and to a better appreciation of the deleterious effects upon the human organism of energy waste expressed in sound which reaches the brain through the afferent channel of the organ of hearing.

Individual protests against noises, stigmatized as unnecessary, general or community protests against industrial noises have, from time to time, been made and have, in many instances, resulted in an abolition or a modification of the objectionable sound.

As examples of these may be cited the changes made in the lowering of pitch of Italian railway whistles and the limitation of the duration of signals, similar changes controlling the use of marine whistles on the waters surrounding the city of New York, the prohibition of the use of locomotive whistles for purposes of private signaling on some of the American railways, the prevention of factory-bell ringing at early hours, and the substitution of a less public summons to the day's work, the control of the noises of street traffic in the neighborhood of schools and hospitals in large community centers, and the efforts made, in response to the representations of operatives, in some manufacturing establishments, for the effective working not of a soundless but of a noiseless shop. All of these evidences of the appreciation of the existence of conditions prejudicial to comfort and to well-being, coupled with the plaints of members of the community abnormally sensitive to sound, have been progressively educative, and have prepared the way for a general recognition of the fact that the production of the irrelative and therefore inharmonious combination of sounds, to which we give the name of noise, is, in connection with any mechanical process, an evidence of a waste of energy which should go toward increasing the effectiveness of the machine; moreover, that this waste of mechanical energy, expressed in noise, entails a waste of energy on the part of the cooperating human machine, or, in other words, waste of mechanical energy expressed in noise means also a waste of human effectiveness.

It has long been known that continued exposure to loud noise results in degenerative changes in the sound-transmitting portion of the human ear, and that persons following noisy occupations, metal workers, jig sawyers, and factory operatives of various kinds, become in time subject to impairment of hearing, and present also objective changes in that portion of the sound-transmitting apparatus open to inspection through the external auditory canal.

These changes from the normal are mainly an indrawing of the drumhead and a generally distributed capacity of what is normally a semitransparent membranous structure.

Normally the drumhead, viewed from without, presents a generally concaved surface, the concavity being due to a depression of its central portion incident to the attachment of the membrane to the first bone of the ossicular chain, the malleus, and the pull inward of the tensor tympani muscle thereto attached.

Under the influence of the changes incident to continued exposure to loud sounds, the drumhead becomes more concave, because of the increased contraction of the tensor tympani muscle, and more or less opaque, because of the thickening of the mucous membrane lining the middle ear and forming the inner coat of the drumhead.

Both of these changes are the result of an effort at protection of the deeper-seated and more delicate sound-transmitting apparatus of the internal ear; the contraction of the tensor tympani muscle hindering the movement of the drumhead, as a whole, and the thickening of the mucous coat decreasing the segmental vibration.

The movement of the sound-transmitting apparatus of the middle ear, in response to the impact of sound waves entering through the external auditory canal, is to be regarded as grossly molar when compared with the incident movement of the sound-transmitting apparatus in the internal ear, where the motion is finally transferred to the nucleate cells receiving the terminal fibers of the auditory nerve, where the motion is transformed from molar to molecular.

The transmission of sound waves to the internal ear takes place, not only through the channel of the sound-transmitting apparatus of the middle ear, but also through the body, as a whole, and less through the medium of the soft tissues than through the skeletal structure, wherein its transmission is hindered by the interposition of such sound breaks as joints and sutures, and is most direct when the sound source is directly applied to the bone in which is incased the bony capsule of the internal ear.

It follows, therefore, that an individual working daily in a mechanically created noise, often accompanied by mechanically created vibratory action, is subject to changes in the auditory apparatus prejudicial to the continuance of its function, and that the continuance of this state of affairs is productive of waste of human effectiveness.

Until recently the objective evidence of these changes has been confined to their exhibition in the middle ear, but the earlier investigations of Moos and Steinbrügge into the pathology of the internal ear, incident to inflammatory and suppurative processes, have now been paralleled by the study of degenerative intralabyrinthine changes incident to such causes as that with which this communication deals.

Notable among these contributions have been those of Siebenmann, who demonstrated at the recent meeting of the Ninth International Otological Congress the cochlear lesions of a degenerative character consequent upon prolonged occupational exposure to loud noise, and also those immediate lesions incident to exposure to a loud sound with major force value and of sudden impact.

This scientific evidence, in the line of effect from recognized cause, serves to emphasize the justifiability of concerted action in the direction of further investigation as to consequences and further study as to means and methods by which an objectionable and growing factor in modern life may be suppressed.

The effect upon the organ of hearing is only a small part of the argument in favor of the suppression of unnecessary noise, the effect upon the nervous system as a whole, especially in those whose power of resistance or of compensation has been decreased by fatigue or by illness, must be considered, and in the well and mentally active the inroad upon the attempted continuity of a mental process resulting from the environment of an irregular, inharmonious, and penetrating sound have to be reckoned with in the estimate of the desirability of a general recognition of an offense which should be as little tolerated as any other unhygienic condition.

The fatigue element, in the effort at mental elimination of an intrusive sound, even though the effort has come to be almost subconsciously exercised, may be justifiably reckoned with in the estimation of the causes of the so-called nervous overstrain, while the increase of inventive endeavor toward the elimination of noise in the mechanisms most in daily use are illustrations of the growing appreciation of the now scientifically demonstrated truth.

In the case of subjection for a prolonged period to a very intense sound of high pitch, it has been found that the lower portion of the membranous cochlea, that portion devoted to perception of tones of high pitch, has undergone the most degenerative change, and the proximity of this portion of the cochlear tube to the vestibule and to the organ of equilibration suggests something more peripheral than the central organ, with its multiplex lines of reflex communication, as the possible source of the vertigo which sometimes accompanies the auditory discomfort incident to long exposure to continuous tones of high pitch.

In the presence, therefore, of accumulative evidence of the unhygienic character of noises, beyond the limit of requirements of public welfare and safety, in view of the growing volume of noise incident to the increase in traffic and in manufacture, and to the extension of the various public-service utilities, and based upon the scientific testimony to the actuality of the objectionable effects of noise upon the human economy, and the constitution thereby of another form of human waste, the discussion of this subject should be upon the program of every conference upon the subject of hygiene and sanitation. It should be dealt with, in some form or other, from the human side, in every international otological congress, and it should be a permanent part of the purpose of existence of an institute of otologic research which, it is hoped, may some time be founded both for the solution of the increasing number of otologic problems and as a bureau for the dissemination of information upon such acoustic questions as may have become matters of public concern. The establishment of such an institute, especially in connection with one of our larger universities, would constitute a contribution of inestimable value to public uses in the particular form of scientific research which has to do with the study of the production of sound, its transmission and its control.

EXISTING LEGAL PROVISIONS WITH REGARD TO THE SUPPRESSION OF UNNECESSARY NOISES.

Stoughton Bell (A. B., L. L. B.), Boston, Mass.

I find no general statute covering the suppression of unnecessary noise. In many States particular noises are prohibited by statute, as, for instance, the cutting out of mufflers on automobiles and the muffling of the exhausts of motor boats. In Massachusetts local boards of health are given authority by statute to pass regulations to prevent noises that are dangerous to the public health. These regulations may apply to noises made within certain parts of the town or city, or they may be general in character and apply to the whole town, as in the town of Plymouth, where the making of unnecessary noises by the exhausts of motor boats has been prohibited. There is a statute in Massachusetts which provides that exhausts of motor boats shall be muflled in a reasonable manner, but this was considered difficult of enforcement, and the board of health in that town believed it to be necessary to pass a regulation which should be more definite in character. In Massachusetts the railroad commission can prevent the blowing of whistles and the ringing of bells on steam engines when they are disturbing to the inhabitants at a particular crossing, or in a particular village. No authority, however, is given to the railroad commissoiners to pass any general regulation with regard to these, and it is only after a hearing that they can prevent them in a particular locality.

In the absence of statute, or of regulation passed under authority of the statute, noises may be abated because they constitute a nuisance. In Blackstone we find that "a nuisance (nocumentum) or annoyance, signifies anything that worketh hurt, inconvenience, or damage," and "whatsoever unlawfully annoys or does damage to another."

A nuisance may be either public or private. If it be a public nuisance, it is a loud noise disturbing a neighborhood. If it be a private nuisance, it is a loud noise resulting in depreciation in the value of, or in damage to, property.

There are no fixed limits which govern either public or private nuisances. Each case must be judged by itself. The purpose for which the noise is made, the character of the noise, the place where it is made, and the time of making, must all be taken into consideration. It might well be that a person who owned a dwelling house in a strictly residential neighborhood might be enjoined from conducting therein a tinsmith shop, while that same person could not be enjoined, were he to make much more noise tearing down and rebuilding his dwelling house. In the one case, the noise would not be reasonable for that locality, and, in the other, the only reasonable use of the land must permit the tearing down and rebuilding of the structure and the noise attendant therewith. But even the noise of tearing down and rebuilding might be enjoined, if it were carried on at night, and if it were found that work at night was not necessary.

The care with which each case must be considered can best be illustrated by an examination of a case of private nuisance recently decided in our Massachusetts court, which had to do with the suppression of noises made by dredgers and tugs used in building the new Cape Cod Canal. The case was referred by the court to a master to find the facts and report thereon. A brief statement thereof is as follows: It appeared that, in order to complete the work of dredging the canal, it was necessary to use three dredgers. A number of persons who had summer places in the near neighborhood were disturbed by the noise made, and claimed that the value of their property was depreciated as a result, and brought suit to have it enjoined. The master found that, owing to the lateness of the time of beginning the dredging at this particular point, it was necessary to dredge both night and day. He found that there were two kinds of dredgers in operation, one having an endless chain to which buckets were attached, which creaked and made a great deal of noise, and the other two of the usual scoop construction. He found that there was no unnecessary noise connected with any one of the three dredgers; that they were all operated as quietly as was consistent with good results; that the purpose for which the dredging was done was a necessary one; and that, when operated at night, the dredge having the endless chain was a nuisance, and would be a nuisance to these complainants if located in any part of the canal that was then being dredged; that another dredge when operated at night was a nuisance in the particular location where it was at that time. No one of the dredgers, when operated by day, was a nuisance in the particular location where it was at that time; that the third, when operated at night, was sufficiently far away from those who were complaining, so that it did not constitute a nuisance.

In connection with these dredgers, it was necessary to use scows to carry the material which was taken from the canal to other points for dumping, and two tugs were used for this purpose. Complaint was made that there was an unreasonable noise made by the whistling of the tugs. The master found that under the national pilot laws some whistling was necessary when the tugs passed one another and when they approached the dredgers. He found that the amount of whistling which the tugs did in complying with this national law was unreasonable, and ordered that they should reduce the noise to the minimum required by it. It was complained that the noise made by the dredgers in whistling to the tugs to bring up empty scows and to take away those that were filled was a nuisance. The master found that this could be done as well by the use of signal lights, and ordered that all whistling for this purpose should be stopped. It was also complained that the dredgers used the whistles at night to wake the men, when they were ready for a shift in the gangs at work. The master found that this was unnecessary, and ordered it stopped.

He found, then, that the purpose of all this work was a proper one: that it was necessary that the work should be done by night as well as by day, and, in studying the character of the noises, he distinguished between the two kinds of dredgers, claiming that all three were proper dredgers to be used in the daytime; that one was an improper dredge to be used at night; that another was a proper dredge to be used at night, but that, in the particular place in which it was situated, it unreasonably disturbed those who were in proximity thereto, and, as I have already said, he distinguished generally between the night and the daytime in determining the question of whether or not the noise constituted a nuisance.

In every case, a noise will be enjoined only when it is shown to affect injuriously a person of ordinary sensibility, and not those who, because of their physical or mental condition, or other causes, are particularly susceptible, otherwise the question of whether or no one was committing a private nuisance would depend upon the state of health of the person affected, and a manufacturer might be committing a nuisance to-day merely because a particularly susceptible individual was in the neighborhood, while on the following day, or even the following moment in the day, if that particular person had left, he could continue his noisy business lawfully.

I have outlined above some of the general principles governing the regulation of noise. I have not attempted to go into all the details nor the questions of fact which would naturally arise were the question of preventing a specific noise before me. I have not mentioned the law governing the case of noises made with malicious motive or for improper purpose.

In closing it may be well to say a word with regard to any suggestive preventive legislation which may be before you for consideration. It is important in drawing any new act to present to a legislative body to carefully consider all of the various phases of the subject to which I have made reference above. In Massachusetts we have a law which requires that the exhausts of motor boats shall be muffled in a reasonable manner. There is no one who can determine in advance exactly what "muffled in a reasonable manner" is, and each case must be determined on its own merits in accordance with the whim, may I say, of the particular judge before whom it is heard. This is unsatisfactory legislation; unsatisfactory to the prosecuting officer and unsatisfactory to the person against whom complaint is made. Were a definite distance fixed by statute beyond which no noise must be heard from the exhausts of motor boats it would be an easy matter to determine exactly whether or not a particular boat was complying with the law. Great care should be used to see to it that a statute shall be so framed that those who desire to comply with the law can, from its wording, determine exactly what is meant.

Another instance of preventive legislation of the same kind, but from another point of view, is that which was enacted in Massachusetts that requires that in a thickly settled part of a city or town no bell, horn, or other device for signaling shall be sounded on an automobile so as to make a harsh, objectionable, or unreasonable noise. The purpose of this statute was to provide a warning signal, or rather to prevent the unnecessary use of a warning signal in thickly settled districts. It should not, however, be so reduced that it is not a distinct and emphatic warning to those who are on the highway. Under this law, accidents decreased 30 per cent in one year in the country districts of the State, but in the cities they increased 18 per cent. The noise which is required to warn a pedestrian or the driver of a vehicle in a thickly congested district should be, in my opinion, a distinct warning signal. It should be short and sharp and should be no more than is necessary to save or protect the lives of those upon our streets; and this very sharp, short signal should not be prevented in the noisy localities, but it should be regulated so that it can be used only as a warning of danger. It will then mean something to those who use our streets.

I have referred to these two specific statutes in order to call your attention to the difficulties which may arise in connection with any proposed statute. I am not suggesting the necessity of additional statutory law. In the case of the Cape Cod Canal work the law on the subject was adequate to stop this making of unnecessary noise. In any movement for additional legislation to suppress unnecessary noise the greatest care should, in my opinion, be used, else the law as framed will defeat its own purpose and public opinion will be aroused against it.

DISCUSSION.

Prof. JAMES J. PUTNAM, of Boston: The time has come when needless noises must be classified as common plagues, like flies, mosquitoes, rats, and dirt. In eliminating them we must decide what noises are unnecessary, and what complaints against noises are reasonable ones. Much has already been done toward the abolition of unnecessary noises. The work of Mrs. Isaac L. Rich in effecting a mitigation of the noises near the hospitals and along the river front in New York City, is well known; and, in Germany, they have gone so far in certain communities as to declare even private noises, such as piano playing at all hours, to be a public nuisance.

People are sensitive in different degrees to noises. The ability to fix the attention away from noises helps one to withstand them, and the gain of this ability is the important element in "getting used" to noisy sounds. But noises undoubtedly cause a subconscious strain of the attention, productive of fatigue, and the liability to this strain also varies greatly. Experiments dealing with this point have been made by Wundt, Mosso, and others, and many references of value are given by Miss Josephine C. Goldmark, in her book "Fatigue and Efficiency," published recently by the Sage Foundation.

On the other hand, noises are sometimes objected to, not so much or not only on their own account, but because they are felt to be unnecessary, or because they suggest unwelcome thoughts. Some noises of these sorts one may learn to disregard, as the noise of children at play, which is far less hard to bear if one puts oneself, in imagination, in their place, or fancies oneself playing with them, and the like.

In working to secure quieter environments, sacrifies must be required of some persons for the sake of others, and also a mutual forbearance must be shown. At present tradition has too strong a hold upon us. We are too ready to allow the ringing of church bells at any and every hour and permit the sunrise of every public holiday to be greeted by a vast tumult of noises, whether people who will hear them may be sick or well. There is no sense in our adhering to such customs. Where a reasonable number of people request the removal of noises that can be easily removed the burden of proof should lie with the opponents; and the fact that the latter do not mind the noises objected to should not count too strongly for them. The modern man is a more sensitive being than his prehistoric, or even more recent, ancestors, and also more intelligent; and

while he should see that he uses his reason and increased power of self-control to prevent himself from making unreasonable demands, he may fairly insist, on his part, that he shall not be forced to endure any unnecessary strains.

STIMMHYGIENE, IHRE BEDEUTUNG UND IHRE ORGANISATION IN PREUSSEN (DEUTSCHLAND).

Prof. Dr. Th. S. Flatau, Leiter der phonetischen Abteilung bei der Kgl. Universitäts Ohren- und Nasenklinik, Berlin, Germany.

Meine verehrten Anwesenden: Wenn es auch seit langer Zeit bekannt ist, dass mit dem Verlust der Stimme Berufsstörungen verbunden sind, so ist die hervorragende Bedeutung dieses Zusammenhanges doch erst deutlich geworden seitdem die laryngologische Wissenschaft diesen Funktionsstörungen von der Seite der klinischen Pathologie her nahe gekommen ist. In Preussen and zum Teil auch schon in den anderen Staaten Deutschlands hat sich im Verfolg dieser Beobachtungen, an denen ich wohl zuerst und wesentlich im Sinne der exakten Diagnostik und Therapie und ebenso für die präventive Organisation teilnehmen durfte, zu einer Reihe von Einrichtungen und grundsätzlichen Anschauungen geführt, die ich in dieser Versammlung in kurzer Form niederlegen und zur öffentlichen Diskussion stellen möchte.

LEITSÄTZE.

The hygiene of the voice is an important part of physiological and professional hygiene.

There are professions based on the use of the voice in which the free and perfect use of the vocal organs is an essential condition of the social existence. In the artists' professions even the small irregularities bring danger.

(2) The principal types of the vocal professions are according to the different modes of function: The art of singing, the art of speaking (recitation), the voice of command (in the army or the school).

(3) Each of these forms of coordination can be disturbed without affecting the other.

(4) One gets an idea of the immense increase of disturbances due to the use of the voice in professional work by hearing that the most common functional disturbance of that kind, namely, the phonasthenia of singers (the dysodia), occurs in about 80 per cent of that profession.

(5) In consequence a great many individual existences break down, and great social, mental, and financial sacrifices are brought about in vain.

(6) In Berlin and its suburbs one can count about 80,000 to 100,000 professional singers, teachers, and other persons in the army or in the schools who use professionally the commanding voice.

Among these about 60,000 suffer from functional disturbances of the voice.

Quite similar is the case with preachers, actors, members of parliaments, and other political speakers.

(7) In consideration of the phonasthenia, of which I published in 1906 a monograph containing a systematic description of 100 clinical cases, it could be proved that the former methods of the laryngological examination alone were insufficient.

(8) Besides the old methods, there are new methods, invented by utilizing the acoustic and the other physical control of the function. Corresponding to that progress in diagnosis are also found new therapeutical measures, especially the electromechanical method of diagnosis and treatment, which I introduced some years ago.

(9) The essential cause of professional vocal trouble is the qualitative and the quantitative misuse of that organ.

(10) Extended examinations have proved that even in school the foundations of vocal troubles can be laid through a misunderstanding in the technical fundamentals of the development and adjustment of the voice.

(11) For the prevention of this prominent and increasing professional disease. special organized medical and pedagogical arrangements are necessary.

(12) A good many have already been established by the Prussian ministry of education.

(13) The prophylaxis is based on: Scientific and systematic lectures, with practical exercises for teachers in public schools and colleges; physiology of the voice. The training of the teachers in hygiene now takes two years. At the end of that "biennium" the students have to undertake a State examination. The students (teachers) are gradually drafted to those lectures from all the different parts of the Prussian Provinces.

(14) I can assure you that the above-mentioned measures have proved to be practical and successful, and we dare hope that the hygienic education of the singing teachers is organized in the same methodical way.

(15) Special medical arrangements have been made for the phonetical treatment of all the different forms of vocal troubles. first at the Royal University. at clinical institutes for ear and nose diseases at the Charity Hospital in Berlin. and since that, following this example, at other universities as well.

(16) In these departments all the different branches of phonetical therapeutic methods are studied and carried out, for the benefit of all those persons suffering from vocal troubles who are unable to afford private treatment.

TUESDAY MORNING, SEPTEMBER 24, 1912.

DIE BESCHÄFTIGUNGSNEUROSEN.

Prof. Dr. L. v. Frankl-Hochwart, Wien.

Unter Beschäftigungskrampf verstehen wir eine Innervationsstörung der Muskulatur, welche sich nur bei einer bestimmten komplizierten, durch Uebung erworbenen Tätigkeit derselben einstellt, während die Muskeln bei jeder anderen Aktion dem Willen gehorchen (Oppenheim).

Bell scheint zuerst die Aufmerksamkeit auf hiehergehörige Fälle gelenkt zu haben; später wurde die Schreibstörung, die bestbekannte, hiehergehörige Neurose von Brück in Jahre 1831 und Gierl im Jahre 1832 genauer studiert; bald folgten Alberth und Hayfelder. Erst in den 50iger Jahren kam man zur Kenntnis ähnlicher Neurosen bei anderen Beschäftigungen. Ein genaueres Wissen verdanken wir jedoch erst dem Eingreifen von Duchenne de Boulogne (1860) und Benedikt (1874). Letzterer Autor prägte den Ausdruck "coordinatorische Beschäftigungsneurosen" und unterschied (1) die spastische Form, (2) die paralytische, (3) die tremorartige; spätere Autoren (Gowers, Oppenheim u. a.) fügten noch (4) die neuralgische Gruppe hinzu. Unter den neueren Autoren, welche sich dem Studium dieser Affektion besonders widmeten, nennen wir: Bernhardt, Oppenheim, Onimus, Macé de Lepiné, Gowers, Remak jun., Dana, Ramsay, Hunt, t. Williams.

Es ist selbstverständlich, dass anfangs zur Zeit der allmählichen Entwicklung der Neurologie gar manche Zustände unter dem gemeinsamen Namen zusammengeworfen wurden, die nicht alle zusammen gehörten. Ich erinnere da an die irrtümliche Einreihung der Tetanie, ferner mancher cerebraler oder cerebrospinaler Zustände, an die Verwechslung mit Neuritiden—eine Verwechslung, die sich heute noch manchmal in der Literatur geltend macht.

Es soll nun systematisch versucht werden alle die Zustände zu skizzieren, die differentialdiagnostisch in Betracht kommen. Wir wollen der Reihe nach besprechen: (1) Die organischen Cerebralerkrankungen, resp. Cerebrospinalerkrankungen (Tabes, Paralyse, Sklerosis multiplex, etc.); (2) die "Tremores;" (3) Tic, Chorea; (4) Neurasthenie, neurasthenische Brachialgie, Hysterie, Angstzustände; (5) die Vergiftungen; (6) die professionelle Neuritis und deren Entstehung (*a*) in paralytischer Form durch Kompressionen und Ueberanstrengung, (*b*) in neuralgischer Form, (*c*) in Form von Beschäftigungskrämpfen auf peripherer Basis; (7) ist noch zu besprechen die Differentialdiagnose von den Angioneurosen, Akroparästhesien, von der Dysbasia angiosklerotika und (8) die Differentialdiagnose bezüglich der Lokalerkrankungen (der Muskeln, Gelenke, Sehnen und Knochen—davon manche auf traumatischer Basis).

Unter den (1) Cerebralzuständen ist es die multiple Sklerose, die manchmal zu Irrtümern Anlass gibt; manchmal ergreift sie zuerst die rechte obere Extremität allein. Wenn ein solches Individuum, z. B., einen Schreibeberuf hat, wird sich die Störung natürlich besonders bei diesem Geschäfte geltend machen.

Es kommt auch vor, dass Paralytiker unter ähnlichen Verhältnissen anfangs als Beschäftigungsneurosen geführt werden; eine einigermassen eingehende Untersuchung wird natürlich den Irrtum sofort aufklären. Auch die Ataxie der cerebrospinalen Lues und der Tabes wird nur höchst oberflächlichen Aerzten eine Quelle von Irrtümern sein. Etwas anderes ist es bei der sich hier eventuell anzureihenden Paralysis agitans, die ja auch die Elemente des Spasmus, des Tremors und der Schmerzen in sich birgt, die ja erfahrungsgemäss an einer oberen Extremität einsetzen kann, die eventuell am meisten überanstrengt wurde. Der Kenner wird nicht lang im Zweifel bleiben: die Zustände treten bei näherer Beobachtung selbst im Beginne schon auch unabhängig von der Arbeit auf. Dazu kommt oft noch die permanente Steifigkeit der Muskeln, der sonderbare Gesichtsausdruck, die Hitzegefühle kurzum eine Reihe von Erscheinungen, die eine Verwechslung für die Dauer wohl ausschliessen.

Ueberhaupt geben die (2) Tremores am meisten zu denken, besonders dann, wenn das Zittern das einzige Symptom ist, wie beim sogenannten essentiellen Tremor, beim Tremor hereditarius und bei dem auf toxischer Basis; letzterer macht manchmal auch dadurch eine gewisse Schwierigkeit, weil manche Gifte (so namentlich Alkohol, Nikotin und vielleicht auch Blei) gewiss prädisponierend auf die Entstehung des Schreibkrampfes und anderer coordinatorischer Neurosen wirken. Die Differentialdiagnose wird dadurch erleichtert, dass bei den Tremores das Symptom sich bei den verschiedensten Beschäftigungen und nicht nur bei einer geltend macht. Dasselbe gilt auch bezüglich der Unterscheidung vom (3) Tic. Bisweilen treten die Choreaformen zuerst durch Schreibstörung in Erscheinung; bald wird sich aber dann erweisen, dass die Zuckungen sich auch unabhängig von der genannten Tätigkeit etablieren.

Wir haben so nun das Gebiet der Neurosen betreten, ohne dass wir bisher erhebliche Schwierigkeiten fanden. Nun kommt (4) aber die

Besprechung des Verhältnisses zur Neurasthenie und Hysterie—ein Verhältnis, das uns mehr zu denken geben wird. Die Schwierigkeit muss uns ja a priori klar werden; auch die uns interessierenden Kranken mit Beschäftigungskrämpfen leiden an einer Neurose; sie bieten einen fast negativen Befund. man kennt auch ihre Abhängigkeit von psychischen Faktoren, wir können auch bisweilen gemeinsame ätiologische Einflüsse, so z. B. nervöse Heredität, Erschöpfung, Ueberarbeitung, psychische Traumen, Intoxikationen, sowie auch die Beimengung verschiedener allgemeiner nervöser Symptome aufweisen. Es hat auch nicht an Bestrebungen gefehlt, diesen Knoten einfach zu durchhauen und direkt zu sagen, dass die Beschäftigungsneurosen einfach ein Symptom der Neurasthenie seien. Diesem Bestreben kann man sich aber nicht anschliessen, da es doch eine ganz erklekliche Anzahl von Fällen gibt, in denen keine eigentliche Allgemein-Neurasthenie zu diagnostizieren ist.

Wichtig ist es jedenfalls, gewisse Symptome der Neurasthenie zu kennen, die eine Beschäftigungsneurose vortäuschen können. Mehr als einmal glaubte ich beim Beginne einer Anamnese von Neurasthenikern die Geschichte einer Beschäftigungsneurose herauszuhören, bis mich das weitere Studium des Falles eines Besseren belehrte. Neurastheniker klagen so leicht über Schwere und Müdigkeit der Extremitäten; sie klagen auch gar nicht so selten über Schreibstörungen. Wenn man aber näher zuhört, so konstatiert man eher eine Art Unlust zum Schreiben, nicht selten auch neurasthenische Paragraphie. Es ist auch manchmal zu beobachten, dass sich die Schrift verändert, etwas zitterig—fahrig wird—dabei schreiben aber die Leute flüssig, eher überschnell; berufliche Störungen kommen auf diesem Wege kaum je zustande. Eher wird eine Schreibhemmung durch Verzögerung des Gedankenabflusses provoziert—ein Vorkommnis, das sich ja meist leicht klarstellen lässt. Auch der neurasthenische Tremor ist nicht schwer durch seine Unabhängigkeit von einer bestimmten Arbeit herauszukennen; er verändert übrigens die Schrift nicht merklich. Oft klagen auch nervöse Musiker—meistens sind es öffentlich auftretende—über ein Unvermögen zu singen oder zu spielen. In vielen Fällen bemerkt man, dass es sich nur um eine Art von Aengstlichkeit handelt; der Kenner bemerkt dann vielleicht eine Spur von Unsicherheit, ein minimales Dystonieren; wirkliche Störungen, wie bei den echten Beschäftigungsneurosen, kommen dann nicht zur Beobachtung. Gerade hier muss man die reinen Angstzustände und die sich damit etwa verbindenden Zwangsvorstellungen sorgfältig nach Möglichkeit abzutrennen suchen, was nicht immer ganz leicht ist, da die Leute mit den Beschäftigungsneurosen nicht allzu selten beim Auftreten der Störung auch Angstzustände haben. Man muss zugeben, dass es da Uebergangsformen gibt, deren Einreihung unter Umständen strittig sein kann. Ueber eine eigentümliche Provenienz dieses Pseudoschreibkrampfes berichtete mir einmal ein junges Mädchen: Sie pflegte einmal in Abwesenheit ihrer Schwester deren kleinen Sohn und schrieb ihr in dessen Namen unter Benützung seiner kindlichen Diktate täglich einen Brief. Nun erkrankte der Knabe an Masern—ein Umstand, welcher der Mutter geheimgehalten werden sollte. Infolgedessen musste meine Patientin die Kinderbriefe auf Grund ihrer eigenen Phantasie produzieren; immer hatte sie dabei die Angst, dass sie unwillkürlich doch etwas von dem kleinen Unglück einfliessen lassen könnte. Nach und nach kam aber zu dieser Befürchtung noch Angst vor Briefen überhaupt, dann auch vor dem Schreiben, besonders bei gewissen Buchstaben.

Die Angst als Begleiterscheinung der Zwangsvorstellung bei gewissen Buchstaben und Zahlen könnte überhaupt einmal einen unerfahrenen Untersucher irrtümlich auf die Idee einer etwa vorhandenen Beschäftigungsneurose bringen. Ein interessantes hiehergehöriges Beispiel bieten auch die Neurosen der Barbiere: Dieselben leiden bisweilen an einer noch zu besprechenden Beschäftigungsneurose (Keirospasmus Oppenheim); davon ist wohl die von Oppenheim und auch von mir beobachtete Keirophobie zu trennen—der eigentümliche Angstzustand, der sich bei den genannten Leuten bei jedem Rasierversuch einstellt. Hier muss auch noch der Brachialgien gedacht werden, jener Pseudoneuralgien, wie sie im Verlaufe der Neurasthenie nach Oppenheim ziemlich häufig sind. Sie unterscheiden sich aber von den echten Beschäftigungsneurosen dadurch, dass sie auch unabhängig von jeder Arbeit auftreten.

Aehnlich gestaltet sich auch (5) die Differentialdiagnose von den toxischen Zuständen.

Nun kommen wir aber zum schwierigsten Kapitel (6) zur Abgrenzung von der professionellen Neuritis. Sie hat ja auch die Eigenheit, bei Leuten aufzutreten, die sich professionell überanstrengen und die jeweilig überanstrengte Extremität zu befallen; es ist ja auch klar, dass die jeweiligen Störungen bei der eigentlichen professionellen Beschäftigung besonders in den Vordergrund treten müssen. Wenn wir nun daran gehen die professionellen Neuritiden und ihre Differentialdiagnose zu studieren, so haben wir zum Teil ganz klare Fälle vor uns: Wenn wir direkte Lähmungen, Muskelatrophien, ausgesprochene elektrische Veränderungen, individualisierte Anaesthesien beobachten, so werden wir kaum schwanken. In manchen symptomenarmen Fällen können allerdings bisweilen Zweifel auftauchen. Bezüglich der Verwertung älterer Krankengeschichten der Literatur steigen die Schwierigkeiten, wenn die Befunde nicht ganz genau sind. Bei manchen dieser Krankheitsformen, die ich nicht selbst beobachtete und die ich nur aus der Literatur übernehmen muss, kann ich die Einreihung nicht immer mit voller Sicherheit machen. Ich halte es übrigens für denkbar, dass Uebergangsformen, resp. Kombinationen vorkommen. Ich kann mir denken, dass unter Umständen geringe neuritische Beschwerde Mitveranlassung zur Entstehung von wirklichen Beschäftigungsneurosen geben können—ähnlich wie wir Veränderungen an Sehnen, Knochen, Muskeln auch als hiehergehörige "agents provocateurs" ansehen.

Die Beschäftigungen, die zu echten Neuritiden führen können, sind sehr zahlreich. Ich verweise hier namentlich auf die Studien vom Macé und die ausführliche Darstellung von E. Remak, der ich nun zum Teile folgen werde.

Die Leute, die unter diesen Verhältnissen erkranken, sind zuweilen sehr gesunde kräftige Menschen; öfters konstatiert man aber eine gewisse nervöse Veranlagung, nicht selten Anämie, Alkoholismus, Nikotinismus. Wenn man schwerere Vergiftungen letzterer Art nachweisen kann oder ausgesprochene gewerbliche Vergiftung, z. B., mit Blei oder wenn Lues vorhanden ist, wird man allerdings der Beschäftigung nur die Rolle eines auslösenden Momentes zuschreiben können.

Nun mögen Beispiele von derartigen Neuritiden folgen, die auf Ueberanstrengung oder Kompression, bisweilen auch auf beiden beruhen. Gar nicht so selten findet man Atrophien der kleinen Handmuskeln: So sah Remak bei Plätterinnen schleichende degenerative Atrophie des Daumenballens und auch des vom Ulnaris versorgten Musculus interosseus primus und des Adductor pollicis, besonders links. So berichtet Cassirer ähnliches von einer Arbeiterin, welche in einer Posamentfabrik beschäftigt war; sie muste einen runden Holzpflock fest in der Handfläche eingedrückt halten und ihn dann kräftig umspannen; diese Arbeit musste sie durch acht Jahre täglich zwölf Stunden durchführen. Aehnliches erwähnt C. bei Goldpolierrinnen, Tischlern, Schmieden, ferner bei einem Postdiener, der sehr viele Briefe zu stempeln hatte, ferner auch bei Briefsortierern. Ich sah derartiges bei Graveuren, Cöster bei Zigarrenwicklern; Wertheim-Salomonson beschrieb Atrophie der kleinen Handmuskeln bei Diamantschneidern.

Eine leichte einseitige Ulnarisparese konnte ich bei einem Radfahrer beobachten; mir schien die Ursache in einem zu heftigen Umklammern des Gouvernals zu liegen. Simpson und Destot, welche diese Dinge zuerst beschrieben, glaubten eine Kompression des Os pisiforme supponieren zu müssen. Ulnarisparesen sah ich auch bei einem Kellner, der jahrelang die Hände dadurch überanstrengte, dass er immer eine Anzahl von Bierkrügeln bei den Henkeln in einer Hand trug.

Ulnarisparesen mit Atrophie der kleinen Handmuskeln kommen auch dadurch zustande, dass sich die Arbeiter jahrelang mit dem Ellbogen aufstützen und so den Ulnaris zur Erkrankung bringen.

So sah ich einmal einen Drechsler, dessen rechte Hand so atrophisch war, dass ein Neurologe unheilbar-progressiven Muskelschwund diagnostizierte. Mir fiel aber auf, dass der Fall sonst symptomlos war (keine weiteren Atrophien, keine Sensibilitätsstörung, keine Reflexanomalien etc.). Als ich aber den Patienten um seine Arbeitsgewohnheiten befragte, berichtete er mir, das er seit Jahren so arbeite, dass er das Stemmeisen mit den Ellbogen halte. Ich stellte die Prognose günstig: tatsächlich trat nach längerer faradischer Behandlung Heilung ein. Einen ähnlichen Fall beschreibt Remak, vergleiche ferner die untersuchungen von L. Teleky.

Recht zahlreich sind auch die professionellen Lähmungen an den proximalen Muskeln der oberen Extremität, die ebenfalls teils durch Druck, teils durch Ueberanstrengung bedingt werden. Ein vielzitiertes Paradigma ist die von Bachon beschriebene doppelseitige Radialislähmung der Wasserträger von Rennes, welche eiserne Henkelkrüge mittels des durch den Henkel durchgesteckten Seiles trugen, welches Seil die Oberarme oben drückte. Einmal sah ich bei einem Manne, der in ähnlicher Weise schwere Pakete trug, plötzlich rechtsseitige Radialislähmung auftreten; ähnliche Beobachtungen machten Weber, E. Remak. Bernhardt erwähnt eines Mattirers von Hornknöpfen, der seine Arme durch die runden Ausschnitte eines Kastens zu stecken hatte und allmählich Lähmung aller Armmuskel mit Ausnahme des Deltoides akquirierte. E. Remak beobachtete bei einem Schiffer, der vom Ufer aus gegen einen Kahn ein 6 Meter langes schweres Ruder mittelst der Schulter stemmte, Druckparese des Ulnaris-Radialis-Gebietes. Mehrminder vollständige Plexuslähmungen kommen bei den sogenannten "Kraxenträgern," bei Trägern von Kohlen, Bäumen, Tornistern, schweren Paketen zur Beobachtung.

Viel besprochen ist die die langen Daumenmuskeln betreffende Trommlerlähmung (Nürnberger, von Zander, Bruns). Allerdings sollen bei diesen Leuten auch manchmal Sehnenrisse vorkommen. Merkwürdig sind die plötzlich auftretenden Radialislähmungen bei habitueller grosser Ueberanstrengung des rechten Armes: Ich sah ein derartiges Vorkommnis je einmal bei einem Schmied und bei einem Holzspalter. Gouillain-Courtellement erblickte die Ursache einer partiellen Radialislähmung in einer berufsmässigen Ueberanstrengung durch Taktieren. Aehnliche Paralyse sah Oppenheim bei einem Weber, Féré bei einem Angler.

Leichtere Arbeitsparesen, namentlich im Medianus-Ulnarisgebiet werden besonders bei Formern, Schlossern, Schneidern, Möbelpackern, Bauarbeitern, Steindruckern, Glasarbeitern, Xylographen; Metallbohrern, Gürtlern beschrieben. Bei Kuhmelkern, deren echte Beschäftigungsneurose weiter unten erwähnt werden soll, finden sich auch nach langdauernder Ueberarbeitung Medianus-Ulnarisparesen.

Für die Differentialdiagnose ist auch die Tatsache wichtig, dass Gowers ganz vereinzelte Fälle von Schreiblähmung mit Sensibilitätsstörung im Bereiche des Medianus und Ulnaris erwähnt, Moebius Lähmung und Atrophie der Beuger des rechten Daumens. Bei einer ganzen Anzahl von Berufen ist auch das Auftreten von Serratus-Lähmung nach Ueberanstrengung bisweilen mit, bisweilen ohne Kompression des Plexus beschrieben worden: so bei Schustern, Anstreichern, Schmieden, Tischlern, Seilern, Feldarbeitern, Hutmachern.

Viel seltener sind die professionellen Lähmungen und Neuritiden an den unteren Extremitäten; sie sind meist Drucklähmungen durch Arbeit im kniehockender Stellung. Derartige Erkrankungen wurden zuerst von Zenker und Roth bei Kartoffelarbeitern und Arbeiterinnen beschrieben; sie betreffen zumeist die Peronealgruppe. Eine ganze Reihe von Leuten, die in der angegebenen Weise arbeiten müssen. können ähnlichen Affektionen unterliegen; so z. B. Steinsetzer, Asphaltarbeiter, Tischler beim Abhobeln der Fussböden, Rübenversetzer, Steinklopfer. Ab und zu wird auch über Fälle berichtet, in denen Paresen, eventuell Atrophien der Beine durch Ueberanstrengung entstanden, ohne dass eine kompressive Beeinflussung statt hatte; so bei Nähmaschinentretern, so bei einem Mann, der eine Pauke vermittelst Treten eines Pedals spielte, etc.

Viele der beschriebenen Affektionen verbinden sich, wie bekannt, mit Schmerzen, welche den Paresen und Atrophien vorausgehen, resp. sie begleiten. Viel häufiger sind rein neuralgische Zustände, die dann als objektives Symptom höchstens Druckempfindlichkeit der Nervenstämme aufweisen, daneben leichtere Hypästhesien, bisweilen ausgesprochene Anästhesien, die manchmal die ganze Extremität ergreifen, manchmal nur bestimmten Nervenverbreitungen folgen. Ich glaube, dass es keine schwerere professionelle Arbeit gibt, bei der nicht gelegentlich (6c) das Auftreten neuralgischer Störungen beobachtet wurde. In meinem Krankenprotokoll finden sich nicht wenig derartige Beobachtungen. Remak stellt eine ganze Reihe davon zusammen, so z. B. Schmiede, Gürtler, Zimmerleute, bügelnde Schneider, Wäscherinnen, Zigarrenwikler, Handarbeiterinnen (Häkeln, Nähen, Stricken, Wäschezuschneiden, Bügeln, Spulen), bei Tischlern (Hobeln), Kurbeldrehern, Schlossern, Webern, etc. Ein Gewerbechemiker Remaks, welcher bei der Rübenzuckeruntersuchung etwa 500 Mal täglich drei Monate lang einen Quetschhahn mittels der ersten Finger der rechten Hand zusammengedrückt hatte, hatte eine Medianus-Neuralgie davongetragen. welche das Schreiben hinderte.

Eine Aufzählung aller hiehergehörigen Möglichkeiten hat wohl keinen Zweck. Ich will nur einige noch besonders erwähnen, die dadurch interessant sind, weil sie zu differential-diagnostischen Bemerkungen Anlass geben: Es ist z. B. sicher, dass bei Leuten, die sich beim Schreiben sehr überanstrengen, Armneuralgien auftreten, die sich dann auch unabhängig von der Beschäftigung geltend machen. Vieles, was auch als coordinatorischer Musikerbeschäftigungskrampf gilt, ist gewiss besser hier einzureihen. Niemand wird bezweifeln, dass bei den Musikern echte Beschäftigungsneurosen vorkommen; aber sie sind vielleicht seltener als die hier beschriebenen Neuralgien. Sehr überzeugend sind da die sorgfältigen Studien Zabludowskis bei den Pianospielern. Namentlich scheint bei den jugendlichen Spielern häufig eine Störung aufzutreten, die mit einer Neurose gewiss nichts gemein hat; in den meisten Fällen habe man es nach Z. mit einer Distorsion mit oder ohne Erguss oder mit einer Myositis zu tun. Die Erkrankung entsteht meist dadurch, dass die Tasten für die Hand zu breit sind und dass oft zu weitgriffig geschriebene Kompositionen geübt werden. Allmählich entsteht auf diesem Wege die neuritische Entzündung, die mit heftigen Schmerzen und mit einer gewissen Schwäche einhergeht. In einem Falle beobachtete ich eine ausgesprochene Adduktionsparese des linken kleinen Fingers. Aehnliche Dinge sieht man allerdings seltener bei Spielern von Streichinstrumenten, noch seltener bei Bläsern; von den Erkrankungen der Trommelschläger haben wir bereits gesprochen.

Aehnlich verläuft auch eine für unsere Zeit ziemlich wichtige Beschäftigungskrankeit—die der Stenotypistinnen (Fälle bei Männern fand ich nicht beschrieben). Es handelt sich meist um junge anämische Mädchen, die nach der anstrengenden Arbeit anfangs Schmerzen in den Fingern bekommen, welche allmählich den Arm ergreifen.

Hier müssen noch die Telegraphisten erwähnt werden, bei denen allerdings auch später Beschäftigungsneurosen beschrieben werden. Diese Leute erkranken gar nicht selten an nervösen Leiden (Onimus, Cronbach): besonders sind es die Morse-Telegraphisten; doch sind die, welche sich mit dem Hughes-Apparat beschäftigen, nicht frei davon. Die ersten Symptome sind Schmerzen; oft treten keine weiteren Erscheinungen dazu, so dass die Einreihung in dieses Kapitel berechtigt erscheint. Bisweilen haben dieselben eine nicht näher zu charakterisierende Art, bisweilen werden sie als dumpf, bohrend, stechend, ziehend oder brennend empfunden; manchmal sind sie oberflächlich, manchmal tief, bisweilen scheinen sie dem Verlauf der Nerven zu folgen; Kälte- und Taubheitsempfindungen werden als Begleitsymptome erwähnt. In vorgerückteren Stadien kommt es allerdings auch zu Paresen—bisweilen zu heftigem Zittern, bisweilen zu klonisch-tonischen Krämpfen; hier und da entwickeln sich leichte Atrophieen.

Dass auch professionelle Uebermüdung der Beine Zittern, Schwäche, neuralgische Schmerzen erzeugen kann, ist ja allgemein bekannt. Vielleicht gehört hieher der zuerst von B Schulz beschriebene Tänzerinnenkrampf: die eigentümliche Erscheinung, dass Berufstänzerinnen beim Ausführen des Spitzenpas schmerzhafte Wadenkrämpfe bekommen (diese Form wurde auch vielfach unter die Beschäftigungsneurosen gerechnet).

Es ist vielleicht nicht uninteressant daran zu erinnern, dass Zahnärzte öfters Neuralgien in den überanstrengten Händen bekommen.

(6d) Oben haben wir schon der lokalisierten Krämpfe gedacht, die sich von den eigentlichen Beschäftigungskrämpfen dadurch unterscheiden, dass sie anfangs in einem gewissen Zusammenhang mit der Arbeit auftreten, später sich aber auch unabhängig davon geltend machen. Remak fasst diese Gruppe unter dem vielleicht nicht ganz glücklichen Namen der "Beschäftigungskrämpfe auf peripherischer Basi" zusammen. Er beobachtete derartiges bei einer Kuhmelkerin und einem Zeitungsfalzer; G. Köster erwähnt Aehnliches bei Schneidern, Schuhmachern, Notenstechern.

(7) Sicher besteht zwischen professionellen Neuritiden, coordinatorischen Beschäftigungsneurosen und den sogenannten vasomotorischen Neurosen (Angioneurosen) eine gewisse Aehnlichkeit. Am ehesten könnten die Akroparästhesien wirklich zu Verwechslungen Anlass geben—nicht nur, weil das Symptomenbild einige Aehnlichkeit hat, sondern weil auch diese letztgenannte Krankheit so häufig bei einem bestimmten Berufe, bei den Wäscherinnen vorkommt. Aber der Umstand, dass die Schmerzen und Parästhesien nicht so sehr bei der Arbeit oder im unmittelbaren Anschluss an die Arbeit auftreten, sondern erst meist in der zweiten Hälfte der Nacht, ferner die meist auffallende weissliche oder bläulich-weissliche Verfärbung der Fingerspitzen weisen auf die richtige Spur. Ferner geben die Leute oft ganz bestimmt an, dass das Leiden durch Eintauchen der Hände in kaltes oder warmes Wasser bisweilen in günstigem oder ungünstigem Sinne beeinflusst wird. Ein weiteres diagnostisches Hilfsmittel bildet der Umstand, dass die Akroparästhesien zumeist bei Frauen auftreten und zwar sehr oft im Zusammenhange mit der Maternität (Gravidität, Menopause).

Hier schliesst sich eine Affektion an, die vielleicht einmal zu differentialdiagnostischen Bedenken Anlass geben kann; allerdings schützt schon die Seltenheit derselben einigermassen davor; ich meine das intermittierende Stottern der Brachialarterie (Dysbasia intermittens angliosklerotica). Langbekannt ist ja das intermittierende Hinken der Beine der Arteriosklerotiker: die bei längerem Gehen auftretende, von Schmerzen begleitete transitorische Gehstörung; als Begleitsymptom konstatieren wir gewöhnlich mit

Erb ein Fehlen des Pulsierens der Arteria dorsalis pedis. Eine allerdings seltene Analogie findet sich auch an anderen Arterien, so unter anderm auch an der Brachialis (Nothnagel. Kronenberg, Macé, Erb, Schlesinger, E. M. Williams u. A.). Auch bei dieser Affektion zeigen sich Parästhesien, Verfärbungen, krampfartige Schmerzen bei der Ausführung mancher Bewegungen; ein gewisser Einfluss psychischer momente ist nicht selten zu bemerken. Doch weist schon die allgemeine Arteriosklerose. noch mehr aber das Fahlen des Pulses der Armarterien, das Auftreten bei den verschiedensten Beschäftigungen bald auf die richtige Fährte.

Nachdem wir nun die eigentlichen (organischen und nichtorganischen) Nervenkrankheiten und die Gefässerkrankungen in ihrer Differentialdiagnose genug beleuchtet haben, so erübrigt es uns noch darauf hinzuweisen, dass auch durch lokale Muskelerkrankungen (Myositiden, Gelenk- und Sehnenerkrankungen) Störungen hervorgerufen werden können, die an Beschäftigungsneurosen erinnern; man vergesse auch nicht, dass durch Ueberanstrengung derartige lokale Veränderungen namentlich an den Sehnen mitprovoziert werden können. Es ist auch gewiss nicht zu selten, dass chronische Periostitiden Anlass zu Zuständen geben können, die an Beschäftigungsneurosen erinnern und sich auch durch Ueberanstrengung bei einer bestimmten Beschäftigung erklären lassen. Namentlich wurde man in neuerer Zeit auf die Erkrankung des Epicondylus aufmerksam, wie sie z. B. bei den Tennisspielern häufig beschrieben wurden; ähnliche Dinge sieht man natürlich auch nach Ueberanstrengung in anderen Berufen.

In den meisten Fällen wird die Unterscheidung ganz leicht sein, wenn man nur genügend genau untersucht; die Lokalerkrankungen machen ja gewöhnlich sehr sinnfällige Erscheinungen. Immerhin ist es möglich, dass geringe Veränderungen an Sehnen und Gelenken unter Umständen zu den mitprovozierenden Faktoren bei der Entstehung echter (eigentlich psychogener) Schreibkrämpfe gerechnet werden müssen (man vergleiche die Beobachtungen von Alois Pick u. a.) Man darf aber solche relativ geringfügige Nebenbefunde nicht überschätzen. Ihre Behandlung kann höchstens einen suggestiven Wert haben und darf nie mit Vernachlässigung der Allgemeintherapie einhergehen. Es ist ja auch klar, dass gröbere anatomische Veränderungen nach Traumen Schreibstörungen verursachen können, die unter Umständen bei oberflächlicher Betrachtung Schreibkrämpfe vortäuschen können; die Lokaluntersuchung wird bald Aufklärung bringen. Unter Umständen schuldigen die Leute oft geringe, bisweilen mit Schreck verbundene, Verletzungen als Ursache des sonst als psychogen imponierenden Zustandes an; das Ganze könnte dann vielleicht einmal dem Bilde einer traumatischen Neurose entsprechen. Ich muss aber diese genannte Konstellation wohl als selten ansehen;

ich habe unter ziemlich zahlreichen Beschäftigungsneurosen nie mit Bestimmtheit ein körperliches Trauma als mit veranlassendes Moment vorfinden können. Umgekehrt habe ich unter tausenden von traumatischen Neurosen nie einen Symptomenkomplex gesehen, der einer typischen coordinatorischen Beschäftigungsneurose entsprach.

Nachdem wir uns bemüht haben, die Differentialdiagnose möglichst klar zu stellen, ist es nun an der Zeit uns mit unserem Hauptthema—mit der Natur der coordinatorischen Beschäftigungsneurosen näher zu befassen. Ich glaube, dass es am besten ist, wenn wir zuerst den Schreibkrampf allein studieren, der ja die bekannteste Form darstellt. Mit Hülfe der dabei erworbenen Kenntnisse ist es leichter in das Verständnis der anderen hieher gehörigen Formen einzudringen.

Wenn wir die Leute mit der besprochenen Schreibstörung übersehen, so fällt es vorerst auf, dass nur Männer daran erkanken; unter meinen 41 Fällen war nur 11 weibliches Individuum. Das Gros der Fälle steht bei Beginn der Affektion zwischen dem 20. und 40. Jahr; zwischen dem 40. und 50. Jahr ist das Einsetzen nicht gerade häufig. Jenseits des 50. Jahres wird die Affektion immer seltener; vor dem 20. Jahr kommt sie nur vereinzelt vor. Unter meinen Fällen fand sich nur ein Mann unter zwanzig Jahren (17jähriger Handelsschüler).

Wiederholt wurden in der Literatur Fälle von Beschäftigungsneurosen der Geldwechsler und Geldzähler beschrieben. Ich habe einmal einen zirka 60jähriger Bahnkassier beobachtet, der im übrigen ganz gesund war; nur beim Geldzählen bekam er Parästhesien, sowie gleichzeitig eine gewisse Schwerfälligkeit der Bewegung, so dass er seinen Beruf aufgeben musste. Auch für unsere modernsten Arbeiter, für die Chauffeure, weiss man schon von einer Neurose zu berichten. Macé erzählt von einem ihm von Dr. Siccard mitgeteilten Fall: Der Chaufeur bekam sofort beim ersten Versuch den Volant zu drehen, Krampf in der Hand, so dass er nicht imstande war das Fahrzeug zu lenken.

Eine andere Gruppe von den uns beschäftigenden Kranken bekommen die Affektion in den unteren Extremitäten: Hierher werden von vielen Autoren die Tänzerinnen-Krämpfe gerechnet (siehe oben). Mehrfach wurden Neurosen bei Leuten beobachtet, die ein Pedal zu treten haben oder die Drehung eines Rades mit dem rechten Bein betrieben (Drechsler, Scherenschleifer, Nähmaschinentreter, Silberarbeiter, Lohgärber, Lochbohrer, Weber, Byciclisten).

Wir haben schon bei Gelegenheit der Besprechung der Beschäftigungsneurosen der Bläser, Sänger und Sprecher gesehen, dass die uns beschäftigende Krankheit durchaus nicht an die Extremitäten gebunden ist. Wir finden Nackenkrämpfe bei "Lesern" erwähnt—bei Leuten, die sich durch Lektüre überanstrengt haben (Andrale, Näcke); doch erinnern die beschriebenen Dinge mehr an einen "Torticollis mental" (Macé). Mehr in unser Gebiet gehörig scheint eine alte Beobachtung Duchenne's: Ein Student hatte sich bei der Vorbereitung zur Prüfungsarbeit sehr überanstrengt und begann nun an starken Schmerzen in den Schläfen, an der Stirne und an den Augen zu leiden. Beim Lesen bekam er Hyperämie des Gesichtes, Stirnmuskel- und Lidkrämpfe, die durch einige Jahre dauerten, aber immer nur bei der Lektüre auftraten; der junge Mann tötete sich aus Verzweiflung.

Wir finden auch einige Berichte, die von dem Vorkommen von Augenmuskelkrämpfen als Ausdruck einer Beschäftigungsneurose handeln; so kann nach Oppenheim nach anhaltenden Mikroskopieren, z. B., bei Fleischbeschauern beim Versuch dieser Tätigkeit ein Krampf im Akomodationsmuskel eintreten. T. Cohn erwähnt bei Uhrmachern Orbiculariskrampf; Tranjen beschreibt einen Excerzier-Augenmuskelkrampf, i. e., einen bei militärisch vorgeschriebenen Augeneinstellungen sich entwickelnden Krampf der entsprechenden Muskeln. Oppenheim meint, dass an dieser Stelle der Nystagmus der Bergleute einzureihen sei; eine ähnliche Störung sah der genannte Autor auch bei einer Violinistin, die gezwungen war berufsmässig Notenschrift von einem erhöhten Pult aus bei schlechter Beleuchtung abzulesen.

Die Prognose der Beschäftigungsneurosen ist keine gute: Ein Umstand ist gewiss von bösem Einfluss; die Meisten der Betroffenen leben—oft recht mühsam—von der jeweiligen manuellen Beschäftigung und können sich daher keine Ruhe gönnen. Ja, im Gegenteil: Je mehr die Zustände zunehmen, umso länger müssen die von ihrem Defekte behinderten Leute arbeiten, um ihr Pensum zu erledigen. Ich habe allerdings auch unter den wohlhabenderen Patienten die Prognose gar nicht viel besser gefunden; Rezidiven nach scheinbar gut gelungenen Kuren sind leider nicht selten. Damit will ich eber durchaus nicht die Unheitbarkeit aussprechen und nicht therapoutischen Nihilismus predigen. Die Krämpfe sind auch in ihrer Prognose nicht gleich: so waren meine therapeutischen Erfolge beim Schreibkrampf nicht immer gute; mehr befriedigend waren sie bei den Musikerkrämpfen; in letzterem Punkte machte auch Oppenheim ähnliche Erfahrungen (mündliche Mitteilung).

Von grosser Bedeutung ist die Prophylaxe: Wir sehen ja, dass die Erkrankung meist die Disponierten trifft. Alles, was dazu beiträgt, die Rasse zu stärken und zu kräftigen, ist auch Schutzwehr gegen die Beschäftigungsneurosen. Hygiene des Lebens, Mässigkeit im Genuss von Alkohol und Nikotin sind notwendige Dinge. Wichtig scheint mir, dass Leute, die in einer bestimmten Richtung manuell zu viel arbeiten, in ihren Freistunden Arbeiten anderer Natur machen, z. B., Gymnastik, körperliche Spiele, Rudern, Schwimmen—vielleicht auch kleine mechanische Arbeiten mit Beschäftigung anderer Muskelgruppen.

Die Besprechung der uns vorliegenden Neurosen birgt auch ein Mahnwort an die Lehrer. Die Erziehung zu einer guten Schreibhaltung ist eine ernsthafte Pflicht derselben; immer möge auf guten Lichteinfall geachtet werden, auf gute Schreibfedern, auf gutes Papier. Man verwende grosse Tintenfässer mit reichlichem Inhalt von dünnflüssiger, nicht zu lichter Tinte, man tauche nicht zu selten ein; das sind scheinbar kleinliche Regeln, die doch ihre ernste Bedeutung haben. Ebenso grosse Verpflichtungen müssen wir den Musikpädagogen auferlegen. Wir sehen die Neurosen gerade so oft bei den jungen Musikschülern, noch mehr bei den Schülerinnen, auftreten. Man überspanne die Kräfte der jungen Leute nicht; man vergesse nicht, wieviel Neuropathen gerade unter den musikalisch begabten Menschen sind. Es gibt entschieden Methoden, die besonders geeignet sind Neurosen herbeizuführen. Beherzigenswert ist der Vorschlag Zabludowskis Jugendklaviere mit verschmälerter Klaviatur zu konstruieren.

Was wir hier von Schreib- und Musikneurosen gesprochen haben, lässt sich mutatis mutandis auch für die andern Beschäftigungsneurosen anwenden.

Alle die prophylaktischen Massnahmen bedürfen aber auch der Einsicht der Arbeitsgeber, die eben darauf bedacht sein müssen, dass die Arbeitsanstrengung nicht zu grosse Dimensionen annehmen solle.

Wir, als praktische Aerzte, bekommen natürlich erst die schon entwickelten Fälle zur Begutachtung und zur Behandlung. Das Erste, was wir zu verordnen haben, ist Ruhe bezüglich der die Neurose provozierende Beschäftigung, wobei andere manuelle Tätigkeiten weiter gemacht werden können, ja sollen. Man behandle das ganze Individuum; man achte auf Arteriosklerose, Alkoholismus, Nikotinismus, man verordne Landluft, Gebirgsluft, See- und Sonnenbäder. Man gebe Nährpräparate, man versuche Eisen, Arsen, Kakodyl; im Ganzen hat man jedoch von inneren Mitteln nicht all zu viel zu erwarten.

Nicht gering mag die Hydro-(Thermo)-Therapie eingeschätzt werden, da sie auf das Allgemeinbefinden grossen Einfluss hat: Laue Halbbäder, Einpackungen, laue Douchen werden mit Erfolg verwendet. In neuerer Zeit wird ab und zu Heissluftbehandlung versucht. Unter den balneotherapeutischen Kuren scheint mir ein Versuch mit indifferenten Thermen berechtigt. In neuerer Zeit geht man daran Radium-Kuren (Bäder, Emanation) zu verwenden.

Seit Jahrzehnten geniesst die Elektrotherapie ein besonderes Vertrauen für die Behandlung der Beschäftigungsneurosen. Vielfach wurde Galvanisation empfohlen: Man verwende 30 cm Elektroden, Ströme von 4 M. A. und zwar entweder stabile Durchströmung oder

Katode an die Wirbelsäule, periphere Streichung mit der Anode. Auch Durchströmungen des Kopfes und der Wirbelsäule werden empfohlen. Weniger Wertschätzung fand die Farado-Therapie; in neuerer Zeit wurden noch Franklinisation, Arsonvalisation, sowie elektrische Bäder verwendet.

Vorsichtige Gymnastik hat ihren nicht geringen Vorteil, noch mehr aber eine geduldige rationelle Massage. Leichte Efleurage, Nervenvibrationen, passive Bewegungen, später Muskelknetungen werden von den Fachmännern empfohlen. Nur mit grosser Vorsicht geht man zu Widerstandsübungen über, zumeist zu solchen, welche der Gymnast selbst manuell gibt. Bum verwendet dazu kleine, mit Blei gefüllte Eimer, welche an die Finger gehängt werden. Man empfiehlt auch noch die Mechanotherapie mit Apparaten nach Herz und Zander.

Wir kommen nun zur Frage des Gebrauches von Schreibapparaten für die Hand. Die Patienten mit Schreibkrampf kommen oft von selbst auf die Verwendung dicker Federstiele; sie erzeugen sich auch solche wohl selbst, indem sie einen dicken Kork verwenden, durch den der Federstiel durchgesteckt wird. Die Industrie hat eine Reihe der verschiedensten ähnlichen Konstruktionen erzeugt. Wiederholt sah ich kugelförmige Federhalter verwendet; andere werden mit Ringen oder Oesen versehen, durch welche die Patienten ihre renitenten Finger stecken. Man gebraucht auch Verbände zur Fixierung des Handgelenkes, appliziert eventuell Holz- oder Metallschienen, um dasselbe in Streckstellung zu erhalten.

Viel Aufsehen hat seinerzeit das Nussbaum'sche Bracelet gemacht: Die Finger werden durch eine braceletartige Spange gesteckt, welche oben die mittelst einer Schraube befestigte Feder trägt; die genannten Finger werden in demselben ausgespreizt und gestreckt gehalten. Sobald die Flexoren in Funktion gesetzt werden, fällt das Bracelet von den Fingern herunter. Zabludowski empfiehlt einen nach verschiedenen Richtungen verstellbaren Federträger.

Eine sehr wichtige—vielleicht die wichtigste Art der Therapie—sind die Schreibübungen, die Reeducation. (Hier handelt es sich natürlich nicht um die Ersatzmittel, wie z. B. Schrieben mit der linken Hand, Verwendung der Schreibmaschine.) Die Leute lernen bei den eigentlichen Uebungen eben neue Assoziationsmechanismen: Gowers empfahl das Schreiben "aus der Schulter." Der Schreiblehrer Wolff hat ein ganzes, seinerzeit sehr bekannt gewordenes System ausgearbeitet. Viele wertvolle Vorschriften über die Angewöhnung des Schreibens grosser Buchstaben, über Aenderung der Körperhaltung, der Armhaltung, der Federführung findet man bei Zabludowski.

Eine kompliziertere Methode der Reeducation hat Kouindjy ausgebildet: Er beginnt mit den verschiedensten Uebungen mit

Münzen, kleinen Ballen, Stäben, die z. B. auf den Rücken der Finger gelegt werden, in die Höhe geworfen, von der Handfläche wieder aufgefangen werden. Nach genügender Vorübung lässt K. die Leute mit nach aufwärts gerichteter Handfläche schreiben. Aehnliche Methoden verwendet er für den Krampf der Violinisten, Pianisten, Telegraphisten. Meige rühmt Uebungen mit Spiegelschrift; er bezeichnet mit fünf kurzen Worten das Ideal des Schreibens der Kranken: Er schreibe " peu, lent, rond, gros, droit."

Wir haben jetzt allerdings wieder hauptsächlich die Therapie des Schreibkrampfes beschrieben. Aber jeder Arzt wird leicht die hier entwickelten Prinzipien auch auf die anderen Beschäftigungsneurosen übertragen. Eines gilt für alle diesbezüglichen Behandlungen: Wir wissen immer besser, dass die meisten der hieher gehörigen Affektionen psychogenen Ursprungs sind. (Man vergleiche da wieder die allerneuesten Untersuchungen von T. Williams.) Immer klarer wird uns, dass hier nur der Arzt helfen kann, welcher Talent, Liebe und Geduld zur Psychotherapie hat. Hier kommt es weniger auf den Scharfsinn der Methode an, als auf den Scharfsinn des Arztes.

Aehnlich wie bei den Schreibern treten auch bei den Malern und Zeichnern hie und da Beschäftigungsneurosen auf: Auch da wieder nicht bei den Künstlern, sondern bei denen, die gewerbsmässig monotone gleichförmige Arbeit möglichst rasch zu leisten haben. Man vergleiche z. B. die Beobachtung von Delthil bei einem Zeichner, der Uhrblätter mit Ziffern zu bemalen hatte. Auch bei Stenotypisten sollen neben den echten Neuralgien ab und zu Neurosen vorkommen.

Wir wollen uns nun zu einer zweiten Gruppe wenden, zu den Musiker-Beschäftigungsneurosen. Sie haben allerdings nicht die grosse soziale Bedeutung der Schreibkrämpfe; für den Neurologen hat die Sache aber ein grosses Interesse, weil die psychische Komponente viel klarer hervortritt. Hier haben wir gerade oft Berufskünstler vor uns, die unter dem Einfluss der gefürchteten Noxe "Publikum" stehen.

Das häufigst gespielte Musikinstrument—das Klavier—führt, wie ich glaube, eher zu den schon oben geschilderten Neuritiden; doch enthält die Literatur auch Angaben über echte spastisch-paralytische Formen; bisweilen wird auch die neuralgische, nicht neuritische Form beschrieben. Aehnliche Störungen wurden auch bei Harmonium-und Orgelspielern beobachtet.

Unter den Saiteninstrumenten sind es zunächst die Streichinstrumente, die uns interessieren: In erster Linie sind es die Violinspieler, auch bei diesen wieder mehr die Virtuosen als die Orchesterspieler. Der Grund mag teilweise in der Ueberarbeitung beim Ueben liegen;

zum Teil aber auch mit der Angstvorstellung des Versagens vor dem Publikum. Wir haben es einerseits mit den Störungen der linken Hand zu tun; andererseits aber auch manchmal mit den rechtsseitigen, mit den Defekten der Bogenführung. An der linken Hand sind es hauptsächlich Fingerbeugekrämpfe, welche das Spiel beeinträchtigen, ja oft unmöglich machen. Manchmal ist es eine Greifschwäche, manchmal liegt eine Nuance von Ataxie vor—eine gewisse Unsicherheit des Aufsetzens der Finger—lauter kleine Dinge, die aber der " Glockenreinheit " des Spieles abträglich sind. Bei Andern hört man wieder über Schwäche und Unsicherheit in der Bogenführung klagen, in anderen Darstellungen wird von Krämpfen in den Fingern und am Deltoides gesprochen, auch kommen Schmerzattaken als Behinderung des Spiels vor. Aehnliche Erscheinungen, wie bei den Geigenspielern, sah ich, gleich Cassirer, bei Cellisten.

Fingerbeschäftigungsneurosen werden auch bei Harfenspielern beschrieben, in seltenen Fällen kommt es auch bei diesen Leuten zur Unsicherheit oder zum Krampf im Beine beim Gebrauche des Pedales. Auch bei Zitherspielern kommen neben den schon erwähnten Neuritiden, wie ich mich selbst an einem Falle überzeugte, Neurosen vor; es handelte sich um Einziehen des rechten Daumens bei jedem Spielversuche.

Bei den Bläsern werden auch die verschiedensten Formen der Beschäftigungsneurose der Hände beobachtet: Ich sah derartiges bei einem Cornet- und einem Flötenbläser; in der Literatur finden sich ähnliche Vorkommnisse bei Klarinettisten, Oboisten, Posaunisten verzeichnet. Schmerzen, Unsicherheit, Schwächezustände werden beschrieben, aber auch Krämpfe sind öfters erwähnt; sie machen sich öfters dahin geltend, dass die Spieler an einer Klappe oder an einem Loche des Instrumentes durch Krampf wie fixiert bleiben; nur nach einiger Zeit gelingt es ihnen, den Finger wieder zu erheben—ein Umstand, der die Leute oft zum Aufgeben des Berufes zwingt. Bei Besprechung der Bläser-Neurosen muss man auch der merkwürdigen Lippen-Zungen-Störungen gedenken (Stadler, Oppenheim, Turner). Sie betreffen Bläser, die bei Versuchen den Ton zu bilden Krämpfe der genannten Muskelgruppen bekamen.

Hier reihen sich in gewisser Hinsicht die Stimmstörungen an. Gutzmann, dem wir nun folgen, teilt sie in drei Gruppen ein:

(*a*) In die Störungen der Sprechstimme, die sich in starker Ermüdung, in Zittern, in unterbrechungen (vox interrupta) und Aphonie geltend macht.

(*b*) Die Störungen der Kommandostimme, die sich als (1) starke Ermüdung mit Reizerscheinung geltend macht, (2) als Herabsetzung der Intensität in der Lage der Kommandostimme, (3) als komplete Aphonie in der Kommandostimmlage.

(c) Die Störungen der Singstimme: (1) Ermüdung mit Reiz, (2) Störungen der Intonation (die Töne werden nicht getroffen oder nicht in der gleichen Höhe gelten), (3) Störungen der Stimmstärke, (4) Störungen der Dauer, (5) Störungen des Klanges (Presston, Gaumenton, Kehlton, der hohle Ton, der verschleierte Ton, der hölzerne Klang, der hauchige Klang, etc.).

Nach Gutzmann entstehen diese Dinge zumeist auf funktioneller Grundlage und basieren auf einer durch fehlerhafte Funktion erfolgten Ueberanstrengung, resp. Uebermüdung.

Als Kuriosum mag noch des Auktionators Zenners gedacht werden, der beim Ausrufen der Zahlen einen Mundkrampf bekam, der ihn hinderte das Gewünschte auszusprechen.

Wir haben nun an Typen eine Reihe der wichtigsten Erscheinungen dargestellt. Es gibt aber noch eine grosse Reihe von Beobachtungen bei den verschiedensten Berufen, die nun ganz kurz dargestellt werden mögen, ohne dass wir Anspruch auf Vollständigkeit machen können. Bezüglich der Details verweise ich noch einmal auf die Darstellung von Macé de Lépinay.

Als Erstes mögen die Nähekrämpfe erwähnt werden, wie wir sie bei Näherinnen, Strickerinnen, Schneidern, Schustern, etc., beschrieben finden: Schwächezustände und Krämpfe der ersten Finger der rechten Hand bilden das Hauptsymptom. Leute, die sich beim Handhaben grosser Scheren überanstrengen, bekommen Krämpfe im rechten Arm und an der rechten Schulter. Aehnliches sieht man bei Leuten, die sich beim Bügeln überarbeiten.

Napias beschrieb Fingerschmerzen und Schwäche bei einem Emailleur von Photographien. Der Krämpfe der Barbiere haben wir schon oben bei der Differentialdiagnose von den Angstneurosen gedacht; Zittern scheint da das Hauptmotiv zu bilden. Bei Schmieden kommt bisweilen ein Schulterkrampf vor: Ueberhaupt erkranken die Leute, welche schwere Hämmer zu schwingen haben, nicht selten an ähnlichen Leiden.

Bei den Kuhmelkern kommen nicht allein die besprochenen Neuritiden vor, sondern auch bisweilen Krämpfe, welche den Neurosen zuzurechnen sind (von Basedow); auch bei Zeitungsfalzern werden ähnliche Dinge beschrieben. Remak beobachtete einen Gaslaternenanzünder, der jedes Mal innerhalb einer halben Stunde täglich einige siebzig Laternen anzündete, eventuell auslöschte und nun allmählich ein Versagen der Finger bei dieser Tätigkeit und nur bei dieser Tätigkeit acquirierte. Nicht selten treten bei Telegraphisten nebst den besprochenen Neuritiden auch Neurosen in Form von Schmerzen, Schwächezuständen und Spasmen auf. Berger sah sehr starke Flexionskrämpfe bei einer Zigarrenwicklerin, Goldmann bei einem Zigarettendreher. Man vergleiche auch die Untersuchungen von

Wilde. Duchenne sah bei einer Blumenmacherin Krämpfe des Zeigefingers; bei einem Fechtlehrer beobachtete er, dass sofort krampfhafte Rotation des Oberarmes nach innen auftrat, wenn der Mann in die "Parade" treten wollte. Ausser der bereits beschriebenen Kellner-Neuritis gibt es auch eine Kellner-Neurose. So sah Runge einen derartigen Patienten, der beim Versuche Teller auf der Flachland bei supiniertem Ellbogengelenk zu tragen, sofort Krampf bekam. Vereinzelte Beobachtungen beziehen sich auch auf Juweliere, Diamantschneider, Holzhauer, Tennisspieler.

Bezüglich der Aetiologie mag zuerst der Einfluss der Heredität besprochen werden: in einzelnen Fällen wird von direkter Heredität gesprochen; allerdings darf man nicht vergessen dass bei neuropathischen Menschen manchmal auch der Anblick von Leuten mit Beschäftigungsneurosen, resp. das Zuzammenleben mit ihnen ähnliche Zustände provozieren. Gallard hat nach Seeligmüller bei 3 Mitgliedern derselben Familie (einen Notar nebst Mutter und Schwester) Schreibekrampf auftreten sehen, obwohl die beiden letzteren keineswegs Exzesse im Schreiben begangen haben. Ein Patient Cassirers ein 15jähriger Schüler, litt an der sensiblen Form des Schreibkrampfes, sein Vater, ein Klavierlehrer am Klavierspielerkrampf. Berger berichtet von einem Schreibkrampf-Kranken, dessen Onkel an derselben Affektion litt. Viel häufiger (aber durchaus nicht immer) findet man in der Aszendenz Nervenkrankheiten anderer Art, wie Neurasthenie, Hysterie, Psychosen, Basedow, etc.

Betrachtet man die von der uns beschäftigenden Neurose betroffenen Leute selbst, so finden wir eine Reihe von solchen unter ihnen, die man auch schon vor Ausbruch der Krankheit unter die Rubrik "Neurasthenie" hätte subsummieren müssen. Allgemeine Erregbarkeit, Depressionen, Phobien, Angstzustände, ferner somatische Beschwerden, wie Kopfschmerz, Schwindel, Herzklopfen, Dyspepsie beherrschen die Szene, kurzum es gibt kaum ein Symptom der neurasthenischen Gruppe, das hier nicht in Frage käme. Bei einer Anzahl von Fällen konnte ich leicht die kongenitale Anlage, i. e., das Frühauftreten von Nervensymptomen in der Kindheit nachweisen; andere hatten die nervösen Symptomenkomplexe später unter Einfluss der verschiedensten Noxen akquiriert. Unterernährung spielt da keine kleine Rolle, bisweilen auch der Alkoholismus; bein meinen Untersuchungen über die Nervenerkrankungen der Raucher habe ich auf den nicht seltenen starken Nikotinismus bei den uns beschäftigenden Kranken hingewiesen (vergl. diesbezüglich meine Monographie über die nervösen Erkrankungen der Tabakraucher, Wien, 1912).

Manche der Patienten sind mit Epilepsie, Stottern und Tic behaftet; Nephritis, Diabetes, Lues und andere erschöpfende Erkrankungen wurden öfters konstatiert. Auch sah man hie und da mit den Neurosen identische Komplexe bei cerebrospinalen Krankheiten (Lues, Tabes, Sklerosis multiplex) auftreten.

Die häufigste Noxe ist die berufliche Ueberarbeitung; Die meisten der Schreibkrampfkranken sind Berufsschreiber, die ausserordentlich beschäftigt sind; oft sind es Leute, die den Tag über unausgesetzt ihrem schweren Beruf obliegen. Da der Ertrag oft nicht reicht, um die Familie nur in der armseligsten Weise zu ernähren, übernehmen die Leute noch Privatarbeiten, die sie des Nachts ausführen. Es ist ja eine alte Erfahrung, dass nicht die Schriftsteller, sondern die Kopisten es sind, die erkranken. Man vergesse nicht, dass auch der gewandteste, fleissigste Schriftsteller Pausen bei der Arbeit macht, ja machen muss, während der Kopist unausgesetzst tätig ist. Ferner ist auch das Kalligraphieren ein Verfahren, das mehr zu Störungen führt, als die saloppe Schreibart der meisten geistigen Arbeiter. Als ätiologischer, resp. als mitveranlassender Faktor wurde vielfach die Einführung der Stahlfeder genannt, da erst zu dieser Zeit die Beschreibungen der Affektion auf grössere Frequenz deuten. Auch mag die Verwendung schlechter Federn, schlechten Papieres, schlechte Beleuchtung, schlechte Körperhaltung, ungeeignete Arm- und Handhaltung oft von Einfluss sein.

Bei einer Anzahl von Individuen findet man jedoch in der Anamnese die Angabe, dass sie nur mässige Schreibarbeit geleistet haben. Ich muss übrigens betonen, dass ich bei einer Anzahl meiner hieher gehörigen Kranken weder Ueberanstrengung, noch Allgemeinneurasthenie nachweisen konnte. Bei manchen von den Kranken konnte ich eruieren, dass sie zur Zeit der Entstehung der Affektion unter deprimierenden Verhältnissen gelebt haben. So erinnere ich mich eines 34jährigen ausserordentlich kräftigen Offiziers, der sich nie übermässig mit Schreibarbeiten beschäftigt hatte und der auch keinerlei neurasthenische Symptome aufwies. Bei näherem Examen eruierte ich, dass zur Zeit der Entstehung der Affektion die Frau des Patienten ein lebensschwaches Kind geboren hatte. Monatelang strengte sich die Mutter und mit ihr der Vater mit der mühsamsten Pflege an; trotzdem starb das Kind. In dieser Sterbenszeit begann sich der Schreibkrampf geltend zu machen.

Sorgenvolle, aufreibende Krankenpflege ist überhaupt ein Motiv das sich nicht selten in den mir vorliegenden Krankengeschichten findet. Interessant ist die Beobachtung Oppenheims, die zugleich ein wichtiges Beispiel für die Bedeutung psychischer Einflüsse bildet. Bei einer Dame entwickelte sich die Affektion, nachdem sie ihren Gatten wegen Paralysis agitans gepflegt hatte; während dieser Pflege fürchtete sie sich permanent auch von dieser Krankheit befallen zu werden.

Manchmal entwickeln sich die beschriebenen Zustände unmittelbar anschlie Bend an einen Schreck oder allerdings ganz selten an ein mit Schreck verbundenes leichtes Trauma. Interessant ist der Fall Oppenheims, in dem sich die Störung in unmittelbarem Anschluss an eine spiritistiche Sitzung zeigte. Nicht unwichtig scheinen mir dreir Beobachtungen aus meiner Praxis, bei denen sich psychischer Chok bei der Entstehung des Krankheitsbildes nachweisen liess: Ein zirka 30-jähriger Beamter hatte mit seiner Familie nicht ohne eigene Schuld in grossem Unfrieden gelebt. Er wurde erst wieder nach Hause gerufen, als seine Mutter plötzlich gestorben war; selbstverständlich war er durch dieses Ereignis tief erschüttert. Man ersuchte ihn die Todesanzeige niederzuschreiben. Als er sich dazu anschickte, versagte ihm die Feder und er konnte kaum mühsam einige Worte schreiben. Der Zustand blieb bis zu dem viele Jahre später erfolgten Tode trotz mannigfacher Kurversuche stabil.

Ich erinnere mich eines anderen Beamtem, der an erheblichem Schreibkrampf litt: Er erzählte, dass er als Soldat eine gute Handschrift hatte. Er wurde in der Unteroffiziersschule mit Andern von einem Affizier in der Kalligraphie unterrichtet. Einmal gab eine seiner Schreibaufgaben dem Lehrer Anlass zum Tadel, den er dahin äusserte, dass eine derartige saloppe Schrift nur von einem Menschen mit schlechtem Charakter geschrieben sein könne. Dieser Ausspruch machte auf den jungen Mann eine furchtbar deprimierende Wirkung und zog einen unheilbaren Schreibkrampf nach sich.

Ein atypischer Uebergangsfall soll hier noch erwähnt werden: Ein etwa 30jähriger Mann berichtete mir, dass er als Student in alcoholicis nicht gerade mässig war. Eines Morgens wachte er nach einem derartigen Exzess mit einem starken physischen und psychischen Unbehagen, mit einem sogenannten "Kater" auf. Unvermuteterweise kam der Briefträger ins Zimmer und verlangte eine Unterschrift; im selben Momente hatte der Kranke die Angst, dass sein Zustand dem Eingetretenen auffallen könnte und dass derselbe bemerken würde, dass Patient vor Zittern nicht schreiben könne. Er kontte seine Unterschrift nur mit grösster Mühe geben; von dieser Zeit an konnte er nie mehr in Anwesenheit anderer Menschen schreiben. Wenn er allein war, war er von Schreibstörungen frei.

Wie gesagt—der Fall gehört streng genommen nicht hieher, da er zur Gruppe der Phobien zu zählen ist. Er mag aber schon deshalb hier Platz finden, weil wir eine Reihe von sogenannten "echten" Scheibkrampfkranken sehen, die, allein gelassen, noch eine gewisse Leistung aufbringen—in Gegenwart Anderer aber ganz versagen.

Wir sind durch die letztbeschriebenen Fälle darüber belehrt worden, dass es unter Umständen eine Art von fast apoplectiformem Einsetzen der Erscheinung gibt: man würde aber sehr fehl gehen, wenn man diesen Verlauf für häufig halten würde. Der gewöhnliche Verlauf ist meist ein sehr schleichender: anfangs treten die Zustände nur ganz sporadisch, nur im Anschluss an besondere Anstrengung auf; allmählich werden sie immer häufiger, immer intensiver: es vergehen aber Monate, ja manchmal Jahre, bis es zum völligen Versagen der Tätigkeit kommt. Gewöhnlich macht sich der Defekt erst im Laufe des Schreibens geltend; während die ersten Worte noch halbwegs leserlich sind, werden die Zeichen immer undeutlicher, bis sie endlich kaum mehr Buchstaben ähneln. Anfangs können die Leute eventuell noch mit Gänsefedern oder Bleistift passabel schreiben; später versagen auch diese Hülfsmittel.

Bei der nun folgenden Besprechung der Symptomatologie wollen wir der üblichen Einteilung in die spastische, paralytische, tremorartige und neuralgische Form folgen, wobei wir hervorheben, dass wir uns wohl bewusst sind, dass Uebergangsarten und Kombinationen durchaus nicht selten sind:

(1) Die spastische Form tritt meist im Gebiete der Beuger auf—am häufigsten sieht man sie am Zeigefinger, dann am Daumen und Mittelfinger, seltener am vierten und fünften. Die Patienten nehmen die Feder in gewohnter Weise zur Hand, schreiben etwa drei bis vier Worte halbwegs erträglich, dann aber zieht sich der Zeigefinger palmarwärts, der Patient streckt ihn mühsam, macht wieder einige allerdings unvollkommene Buchstaben; wieder tritt Krampf auf, nun gelingt ein Spontanstrecken kaum mehr, der Kranke nimmt die linke Hand zur Hülfe, streckt passiv den widerspenstigen Finger, legt ihn nochmals in gestreckter Lage auf den Federstiel, macht wieder einen fast vergeblichen Versuch zum Schreiben. Nun gelingt kaum mehr ein Strich—der Patient ruht aus. Kaum dass er aber wieder ansetzt, fängt das Spiel von Neuem an. Seltener treten Ab- und Adductionsbewegungen resp Oppositionsbewegungen der Finger auf. In anderen Fälen kommt es zu Streckkrämpfen; der Zeigefinger wird manchmal nur ein wenig aufgehoben, so dass den falschen Eindruck einer Willkürbewegung hat, manchmal schnellt er plötzlich in die Höhe. Auch die anderen Finger. namentlich der Daumen, machen die unwillkürlichen Bewegungen mit. Bisweilen nehmen auch die Muskeln der übrigen Gelenke an dem Krampf Teil; ganz selten sind Krämpfe derselben bei ruhig bleibenden Fingern. Beuge-Streck-Seiten-Bewegungen werden ab und zu beobachtet, bisweilen auch Pro- und Supinationsbewegungen im Ellbogengelenk. Quaret-Faslem sah isolierten Schreibkrampf im Pectoralis major und Deltoideus bei einem vielschreibenden Kassaboten. Der Man war 17 Jahre Trompeter gewesen und spannte in seinem Berufe beim Halten seines Instrumentes die beiden erwähnten Muskeln. Putnam beobachtete auch Mitbeteiligung des Trapezius und Sternocleidomastoideus zuerst nur rechts, dann auch links.

Die 2. Form die tremorartige, dokumentiert sich dadurch, dass die Patienten beim Schreibeversuch von Zittern der Hand oder des ganzen Armes befallen werden, so dass die Schrift den deutlichen Tremor-Charakter bekommt. Diese Form kombiniert sich nicht selten mit der nächsten.

Die 3. Form ist die paralytische; ich habe den Eindruck, dass sich da nicht selten ataktische Elemente beimengen, so dass man eigentlich von einer paralytico-atactischen Form reden könnte. Hieher gehören die Leute, welche die ersten Worte oft noch recht gut schreiben; dann tritt aber ein rätselhaftes Stocken auf, ein förmliches Kleben auf dem Papier. Nach kurzer Ruhe gelingen wieder einige Worte; dann wiederholt sich das Versagen in verstärktem Masse, wobei mir eine gewisse Ataxie bisweilen auffiel. Oft ist die Störung nur in den Fingern; sie kann so stark werden, dass die Kranken plötzlich die Feder aus der Hand verlieren. In einzelnen Fällen sah Berger die Schwäche aber ausschliesslich in der Schultermuskulatur auftreten.

Als 4. Form wird die neuralgische bezeichnet: Schmerzen begleiten allerdings auch ziemlich oft die oben beschriebenen Formen. Eine rein neuralgische Schreibstörung ist selten, und manche der hieher gerechneten Fälle dürften eigentlich den Brachialgien und den verwandten Erkrankungsformen zugehören.

Begleiterscheinungen der beschriebenen Formen sind nicht zu zahlreich. Bisweilen erweisen sich die Nervenstämme als leicht druckempfindlich: allerdings hat man hie und da die Idee, dass die Druckpunkte vielleicht etwas hineinsuggeriert worden waren; ebenso mag es sich mit den in der älteren Literatur öfters erwähnten Wirbeldruckpunkten verhalten. Auch bisweilen zu konstatierende leichte Hyperalgesien resp. Hypaesthesien des Armes erinnern an hysterische Bilder. Ich finde fermer vermerkt, dass der Arm bisweiken kälter wird. Schweissausbruch aufweist, sich verfäbt, bläulich-weiss erscheint. Ich habe diesbezüglich nichts Beweisendes gesehen; wenn ich auch die Möglichkeit derartiger Begleitsymptome nicht ganz leugnen kann, so muss ich sie doch für selten halten und ich kann mich des Gedankens nicht erwehren, dass in den älteren Beschreibungen die Abgrenzung von Neuritiden und vasomotorischen Neurosen nicht immer genau genug durchgeführt wurde.

Reflexanomalien werden für gewöhnlich nicht beobachtet. Die motorische Kraft ist in den meisten Fällen sehr gut, in einer kleinen Anzahl leicht herabgesetzt. Bemerkenswert und für die Stellung der Diagnose äusserst wichtig ist der Umstand, dass die Patienten, so unfähig sie auch zum Schreiben sein mögen, für andere Verrichtungen besonders gewandt sein können. Ein Arzt, der an Schreibkrampf litt, war als laryngologischer Operateur sehr bekannt. Ich behandelte einen renommierten Klaviervirtuosen, der durch 30 Jahre Mogigraph war, dessen Spiel aber tadellos blieb. Ich kannte Schreibkrampfkranke, die gute Pistolenschützen waren, auch einen, der die feinsten, schwierigsten Zeichnungen machte.

Ausnahmen davon habe ich—gleich anderen Autoren—ab und zu gesehen: Manche der Leute klagen darüber, dass sie auch bei anderen Beschäftigungen (Musik, Nähen, Schiessen, Zeichnen, Malen, etc.) Störungen bemerken. In manchen Fällen mögen da hypochondrische Vorstellungen eine Rolle spielen, in einzelnen Fällen kommt es vielleicht tatsächlich zu einer minimalen Minderwertigkeit der Leistung; eine deutliche Herabsetzung der Leistungen in hohem Grade habe ich eigentlich nie entstehen gesehen. Doch will ich nicht versäumen zu erwähnen, dass einzelne Fälle in der Literatur verzeichnet sind, die Leute betreffen, bei denen sich im Laufe der Zeit zwei Beschäftigungsneurosen etablierten, z. B., Telegraphistenkrampf neben Schreibkrampf oder Verbindung letzterer Form mit Musik- oder Stenotypistenkrampf.

Wichtiger als diese letzterwähnten, ganz vereinzelten Vorkommnisse ist die Frage nach der Leistungsfähigkeit der zweiten, zum Schreiben nicht verwendeten (meist linken) Hand. Die Patienten haben für gewöhnlich keine Klage über dieselbe; sie lernen oft aus eigenem Antrieb oder auf ärztlichen Rat das Schreiben mit der gesunden Hand und bringen es in relativ kurzer Zeit zu einer genügenden Geschicklichkeit. Bei Manchen der Kranken erhält sich die neue Technik dauernd; häufiger scheint es aber vorzukommen, dass nach einer Reihe von Jahren der Krampf die zweite Extremität ergreift. Ich sah dieses unglückliche Ereignis einmal 12 Jahre nach Erlernung der neuen Schreibart auftreten.

Dass die Leute nebst dem eigentlichen Schreibkrampf auch noch andere allgemeine nervöse Erscheinungen haben, ist ja schon genug gewürdigt worden. Hier mag nur noch des Steigens der Allgemeinnervosität bei den Schreibversuchen erwähnt werden: die Leute werden unruhig, erblassen, bekommen Herzklopfen und können nicht ruhig sitzen.

WHAT OCCUPATION NEUROSES REALLY ARE.

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The term "neurosis," where it concerns occupational disabilities, is a misnomer, for disorders of occupation to which this name has been given are in reality psychodynamic inhibitions or disorders in the habitual series of coordinated associations gained by education in some art. A want of harmony in the controlling of the mechanism is the fault. Hence the disharmony is always psychological.

This is easily proved by the fact that the neuromuscular apparatus which fails to perform a particular occupational act can quite well accomplish any other act, and this by means of the same muscles, nerves, and brain areas. Hence, the interpretations of Hartenberg that hypotonia is the efficient cause of the professional dyskinesias attributed to neurosis fall to the ground. Nor can we accept Kouindjy's explanation of an ataxia, which he believes because of the favorable effects of reeducation.

Hypotonia or ataxia, when present, are mere secondary effects of a primitive dyskinesia induced by a disharmony which has originated ideationally, although the mechanism through which it occurs is largely emotional. The following considerations are explanatory:

The induction of emotions by ideas is more clearly shown in a more acute form than occurs during the steady pursuit of an occupation. We find it best illustrated in the psychogenetic effects of accidents, and the maintenance of these by the patient's own painful ruminations thereupon, through what amounts to chronic fear and its effects upon the internal secretions.

THE RÔLE OF EMOTION.

An accident short of lesion may create in a susceptible person so great a fear as to cause a sudden increase of secretion by the thyroid gland. The recent researches of Crile have shown that this occurs almost constantly in patients with hyperthyroidism when they are frightened by the prospects of an operation; it occurs in these subjects as a result of anxiety or unusual excitement. Crile believes that the thyroid gland is an organ by means of which there is rapidly available a store of an activating substance for the use of the neuromuscular apparatus when there is special need of its greatest power. Such an occasion is presented by the need for escape from danger. As the preservation of the species in locomotory animals may depend upon capacity to respond suddenly with the maximum of vigor against impending danger, there has developed through the long course of phylogeny this special organ of storing and rapidly setting free, when required, such a substance as the thyroid juice. But it would be a mistake to confine the need for the greater activation of the gland to physical escape from danger in the crude sense. In the higher animals, life is no longer regulated by experiences purely phylogenetic by the instincts. It is in the main controlled by ontogenetic incidents which we call experience, and which modify the reactions in fashions incalculably complex. The determinators of these modifications we call association of ideas. Now, quite apart from the fear of bodily harm, there is a vast series of possible events which man seeks to avoid, and which he apprehends as dangers from which to escape. It is reasonable to believe that psychological situations of this kind are capable of reflexly demanding the hyperactivation afforded by the thyroid juice. That is, fear from any source may create a temporary hyperthyroidism.

But that the thyroid secretion is not the only one modified by emotion has recently been shown by a brilliant research of Cannon. He has shown that the emotion of fear in animals is capable of stimulating the flow of adrenal secretion. He demonstrated that, in frightened animals, the blood from the adrenal vein is so rich in adrenal substance as to be capable of inhibiting peristalsis in an isolated strip of intestinal muscle. This is due to the presence of the adrenal substance in appreciable amount, since it requires contact of the latter (with the intestinal strip) in a one-millionth solution at least to inhibit peristalsis.

We knew that the emotion of fear could inhibit gastric secretion, and Pawlow has shown that certain emotions of anticipatory joy can induce a flow of this secretion.

While it lasts, the fear state presents marked physical symptoms. It does so through the intervention of the autonomic nervous system, which can not be controlled directly by volition, except in rare cases, and those only after much practice. One such case I saw in Philadelphia recently with Dr. J. Madison Taylor. This man, an athlete, had devoted much attention to control of his reactions. He is able to provoke at will the pilomotor reflex, which produces the gooseskin appearance. He claims, too, that he can modify the rate of his pulse, but he did not succeed in demonstrating this clearly to me. He is able also to bring tears to his eyes by purely psychological means. Careful analysis shows that none of these reactions occur from pure willing. To produce them he has to assume a peculiar emotional state, which he describes as one of mystery. His introspection of this is not clear enough for one to say that it is not a feeling of horror. He thinks it is not, because it is rather pleasant, but the pleasure may be that of accomplishing something for which he strives. The analysis need not further detain us, for I quote the case only to draw attention to the impossibility of affecting the autonomic nervous system by direct volition, and to show the need of the intermediary of emotion for provoking autonomic reactions.

The above case may be compared with the simpler one described by Babinski, and which I observed in Paris, in 1907. This timorous young girl, without practice in control, was so apprehensive of the pin scratch used to elicit the plantar reflex that she involuntarily drew up foot and leg at the approach of the pin and then occurred pilomotor contraction upon the skin over the upper and outer part of the thigh overlying the muscles (tensor fasciæ latæ reflex), which contract in the defense reaction when one strokes the sole. The patient could not control this response in any way; and its strict localization is unlike that of the preceding case, in whom the goose skin was general when it came at all.

Of course, these cases are somewhat peculiar, but horripilation is a very common reaction to alarm.

Other common consequences are alteration of pulse rate and pressure. The frequency may become more or less than normal and the pressure may be raised or lowered. Perhaps these differences depend upon the neurological type, or they may be functions of the varying responsiveness of the ductless glands in various individuals or at different times.

Upon the digestion, the effects of alarm are well known to be malappetite and constipation with all their accompaniments.

Upon the respiration, fear acts by a complete arrest followed by exaltation, or mere shallowing may ensue. It is a consequence of the inhibition of muscular activity known as fear paralysis. This may be regarded as a phylogenetic mechanism for stabilizing an individual preparatory to efficient action.

The effect of terror upon the flow of urine and control of the bladder needs only mention.

Even the ancients knew, too, how fear arrested the sexual functions.

But the autonomic modifications of secretions soon cease as the fear shock of the accident fades; and, in a few days, at most, the animal experimented upon or the human being insulted resumes stable equilibrium.

PSYCHOGENETIC FACTORS IN MODIFYING IDEAS, FEELINGS, AND ACTS.

Sinistrosis.

But this benign eventually is often interfered with in human beings by the property they possess of reviving in memory the ideas which clothe situations with horror, apprehension, anxiety. Especially prone to this damaging sequence are persons whose imagination has been made rampant by the cultivation of the credulous fears of childhood; their fear reaction to that which they do not understand is a dominant one, and they are easily beset by an idea linked with fear. The commonest of the fears which result from accident or injury is that of bodily harm. It is very hard for a person of this type, when ignorant of his own structure and functions, to shake off the foreboding created by an impressive catastrophe, and it must not be forgotten that what others regard as trifling, the victim may look upon as catastrophic when judged by its possible effect on him.

Prepossession by the idea of one's own disability is an inevitable consequence. This leads to abstraction from and inattention to the affairs of ordinary life, which, if not trifling by comparison in the patient's mind, at least can not claim the attention properly needed. Hence ensues the well-known diminution of the capacity to think, work, or take part in social life. This incapacity, when the patient becomes aware of it, leads him to still further accentuate the result of his injury, and thus to augment his alarm about his health. Thus is constituted the vicious circle of hypochondria. Even a nosophobia may ensue, such as the fear of lost manhood, insanity, paralysis. Alarm at this impending disaster must, of course, be distinguished from the primary alarm due to the accident itself.

The next step in the drama is the reaction against the actual absence of physical signs of injury, and the reassurances of medical men. This takes the form of an unconscious search by the patient of ratification for his belief that he is indeed damaged. Hence arises the familiar exaggerations and falsifications of symptoms. These are made in perfect good faith and honest belief, but they lead to the simulation of disease pictures previously in mind, or acquired in the course of the disorder.

It is only after the patient begins to be convinced in his heart that he is mistaken that there ensues the deliberate self-deception of the desperate effort to preserve the respect of himself and his friends which he feels he would lose by admitting the absence of physical disorder after all.

By means of this mechanism may arise what Brissaud called sinistrosis. Even a favorable settlement of a lawsuit may not remove this attitude. Only skillful psychotherapy will do so; and, in severe cases, considerable time must be allowed to wear down the sinister habit of mind.

This mechanism was clearly illustrated in the case of sinistrosis, which I fully reported to the International Congress of Industrial Accidents at Rome, in 1909.[1] The rapidity of the success of the treatment in this and other cases is due to the thoroughness of the analysis which leads to the comprehension as there described. The treatment consists of rational psychomotor discipline by which the patient is enabled to reeducate himself and get rid of a dyskinesis, which is, in reality, a dysboulia.

THE MECHANISM IN OCCUPATIONAL NEUROSES.

In the occupational psychoses, for so they are, the mechanism is entirely similar, as is well seen in the case which follows:

F. W., aged 30, a telegraph operator, complained of cramping of the wrist and hand while using the Morse sender, the typewriter, or the pen. Cramp sometimes occurs upon lifting a cup to drink, but only if he thinks of it. It occurs also upon brushing his teeth, but only those on the right side. It does not occur upon lifting up articles, unless he uses the fingers alone, when cramp may occur, but he can wind his watch, button his coat and collar, and perform other ordinary acts without cramping.

The cramps.—The movements consist of a flexing of the wrist when using the Morse key; an extension of the ulnar fingers when using the typewriter; a rigidity of the wrist when brushing his teeth; a giving way and radial rotation of the wrist on lifting a cup to his mouth; a rigidity of the whole arm when attempting to write.

He is completely incapacitated from his usual work, but is able to address envelopes in pencil in the rigid fashion mentioned.

The history.—The personal and family history were unimportant, except that he had a nervous sister and was disappointed that he could not follow his father's profession of medicine, and had to work from boyhood. He neither drank nor smoked. Although ambitious, he does not think that telegraphing was his forte, for, though he had tried hard enough, others with less education did better. He had not realized this, however, until he was too old to easily find something else which paid as well. Perhaps he had found learning harder than most people, because he tried to learn at night, while working as a clerk in the daytime.

Although 10 years ago, after falling from a bicycle and dislocating his shoulder, he had worked in pain for five weeks before reduction was made (not, however, at the key, but in writing); no disability had followed. He had not learned the Morse key in the usual way of the lads who pick it up as office boys and evolve into operators, for he began intentionally to learn when he entered an office at 14, and after four years could send 40 to 45 words per minute steadily, with few mistakes.

Origin of the cramp.—The cramp occurred suddenly six years ago with "a kind of loss of use of the wrist, which would go up in the air while he was using the keys." At the same time, the hand would flex. At the period when this occurred he had been sending in the daytime for a stockbroker from 9.30 a. m. to 4 p. m., whereas formerly he had never used the key for more than three or four hours, and that in the evenings. The stockbroker's work had to be done quickly, and he felt it a strain, but he liked it in spite of its arduousness, for it did not seem to interfere with his health, although he had to eat lunch in the few minutes he could snatch at his desk. His only worry, before the cramp occurred, was the fear of not being able to do his work and of losing his position. Just before his disability began he had found that he was not making his letters correctly and could not go fast enough for the work. He had to give up his position in about 10 weeks after the occurrence of the cramp.

Physical examination was in other respects negative, except for an exaggeration of the deep reflexes.

This summary analysis must be compared with and interpreted in the light of those I have published in the Journal of Psychology and Neurology of Leipsic, 1912 (Bul. 19). There, three cases of writer's cramp of different complexity are fully presented, and the method of management which led to their recovery is described, and the principles thereof are set forth. They were, shortly, as follows:

ILLUSTRATIVE CASES OF OCCUPATIONAL "NEUROSIS."

Case I.—A paymaster was obliged to sign over 200 checks a day. After an attack of "grippe" his signature had become a little uncertain, and one day it was refused by the bank. Dread of losing his position further augmented his difficulty; but he consulted me early, and one interview placed him in the way of cure after a few weeks' absence from work. His hardly legible scrawl at that time contrasts sharply with the bold and clear signature two and a half years later. The steps in the treatment were: (1) Discovery of the cause, an induced fear; (2) removal of the besetment; and (3) correction of the awkward position of the hands and the excessive rigidity of the muscles of the arm. This last was accomplished by gymnastics designed to give free movements and by the frequent practice of free writing in a smooth, large, round hand, a little at a time.

Case II.—A woman had always disliked correspondence, and in consequence wrote very rapidly. During a time of domestic stress and anxiety on account of sickness, she was particularly impatient of the Christmas letters she had to write, and the cramp ensued. When I saw her, two and a half years later, however, there was no marked fear affect nor insistent desire to recover. But, in about three months, she gradually became able to write a normal hand without difficulty, as a result of graduated exercises made possible by freeing her mind from the besetment which produced the cramp when she attempted to write.

Case III.—Singer's cramp and pen paralysis in a psychasthenic young woman. At the age of 19 she received, after a concert, an anonymous letter which created shame when she sang in public thereafter. Her anxiety to be a successful singer, in conflict with this shame, produced a pharyngeal cramp, in consequence of which she had to give up singing for some years. Fear of laryngeal tuberculosis also played a part in this. Some years later a period of stress and poor health, combined with hyperconscientious efforts to do full credit to a difficult clerical post, led to writer's cramp. She was sent to me two years later, after various unsuccessful medical and orthopedic attempts had been made to cure her. She was in despair at being unable to write, as she had to make her living; and although she had persevered, she could not face an audience in solo, so that her earnings as a singer were insignificant. After six months of most arduous treatment she became able to write perfectly with both left and right hands, and the singing cramp was greatly improved. She has already taken a clerical position, and is about to take a choir position once more.

In this case the chief difficulty was to overcome the patient's false belief in a physical disease, first in the hand, then in the shoulder; later, in the constitutional state due to a hypothetical tapeworm, and, finally, belief in a cerebral defect of neurasthenic type not psychological in mechanism. Eventual success in removing these beliefs led to the fruitful practice of gymnastic and calligraphic exercises, which before that had only aggravated her disability. (The patient has since relapsed as to writing with the right hand, but has learned to use the typewriter with it; has sung regularly for over a year.)

These cases clearly show the prepossession of the patient by *the idea of disability.* This notion breeds anxiety regarding capacity to perform the task required, writing or singing or what not. The nervous erethism of the anxious state is concentrated upon the apparatus required for performing the desired act of occupation. In this way, there is induced the state known to golfers as "pressing," and seen familiarly in the stammering movements of those who are apprehensive under unusual mental stress in the performance of an act.

Physiologically there occurs an involuntary innervation, lacking in proper coordination, mainly of the muscles about to perform the desired act. Instead of being in a state of tonic relaxation, the normal physiological one, they are already beginning to contract before the voluntary inception of the professional act. Both agonists and antagonists may contract irrespectively of one another.

The condition is quasi volitional, as it is contingent upon the mental processes preliminary to the occupational act. Its incoherence is due to emotion, and the emotion—fear—is due to the idea that the act can not be performed. This idea has arisen in various ways, as shown by the cases.

CRAMP NEUROSIS IS A TIC.

When occupational neurosis is dyskinetic in type, as in the cases cited, the cause of the disability is in reality the preemption of the muscles required in the act by a tonic tic. It is ideational in origin, and conforms in every way to the well-known definition of Janet into which I need not enter here, as I discuss it in the memoir cited and in the current number of the Journal of Abnormal Psychology (September, 1912).

But when there is no question of dyskinesis in an occupational psychosis, the mechanism is essentially the same. For tic is merely a motor obsession contingent upon the idea of certain situations within or without the body. Pure besetment without motor expression is essentially the same in a psychological sense, as so clearly shown by Janet.[2] Neither of these manifestations is ever unaccompanied by phobia or Angst. So much so that some have regarded anxiety as the genetic factor of obsessions. The clinical evidence that this is not so is abundant. That it is the notion of the situation in the patient's mind which is the determinant of the emotional reaction of his body, is shown by a series of analyses of children made by the writer before the American Psychopathological Association (May, 1912),[3] as well as in a theoretical discussion with casuistical illustration.[4]

It is this state of obsession, expressing itself in the fear of one's occupation, which has so unfortunately received the name of neurosis;

for the name leads to the idea of therapeutic intervention toward the lower neurones, such as their stimulation by strychnine and other drugs believed to be tonic in effect; such as by giving douches to arouse the nervous system; by attempts to improve nutrition; through massage, exercise, more nourishing food; by the imposition of rest, on the supposition that there is exhaustion of the nervous system; by prescription of change of scene, under the idea that the patient's balance will be thereby restored. These measures, excellent enough when indicated, are quite beside the mark in the affection we are considering.

The essential preliminary to treatment is the getting rid of this idea. But before this is done, the patient must be thoroughly convinced of the fact that it is this idea that produces the disability, and that his previous belief that the disability is of physical origin, whether of muscle, nerve, or brain, is utterly erroneous. In other words, he must clearly comprehend the phsychodynamic genesis of his condition.[5]

The second step is for him to reacquire control of the psychomotor mechanism required in his occupational acts. This can only be attained by practice. In proportion to the length of time the perverted kinesis has obtained, these efforts to rectify it are difficult and prolonged. Thus the naval paymaster, who had been incapacitated only a few weeks, was restored in less than a month, after one interview. The woman who had practically ceased writing for two and a half years required four treatments and about four months of practice before she could again write freely. The young woman with multiple professional cramps required six months of the most arduous discipline and frequent consultations before she could again write with the right hand and sing without cramp of the throat. In the cases of numerous telegraphers I have studied, no treatment at all was undertaken, because in part of the long standing of their condition; but mainly because the tiring work of a telegrapher does not leave enough energy for the arduous discipline required for reeducating the mechanism of the professional act so complex, delicate, and exacting as the use of the Morse key.

Theoretically, it is clear, and, practically, my cases show, that there is only one direct therapeutic means for them. That may be summed up as psychotherapy.

Of course, the effort demanded in a psychotherapeutic education requires for its best fruit a well nourished nervous system; and the patient's hygiene must therefore be rectified, when defective; but that is only a help, and not a cure.

The same consideration applies to prophylaxis. It is of course desirable that workers should be well nourished, and that fatigue should be minimized; but this, in itself, will not prevent occupational neurosis, if the ideational seeds are not prevented from germinating in the minds of the workers.

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[1] See Transactions; also, Medical Record, New York, May, 1909.

[2] Les Obsessions et la psychasthènie. Paris, 1903.

[3] Jour. Abnor. Psychol., 1913, Am. Jour. Med. Sci., 1912, Dec.

[4] Jour. Abnor. Psychol., July, 1910: The rôle of the affective and intellectual processes in traumatic neurosis.

[5] Much information will be found in author's papers. Recent works upon hysteria, *J. A. M. A.*, Dec. 21, 1912. Ten cases of hysteria, Wash. Med. Annals, Jan., 1912. Postgraduate June, 1912, psychogenesis of physical symptoms is there strikingly set forth.

AN UNUSUAL FORM OF MINERAL POISONING AFFECTING THE NERVOUS SYSTEM. MANGANESE?

Louis Casamajor, M. A., M. D., chief of clinic, Neurological Institute; assistant neurologist, City Hospital, New York City.

A certain indication of the humanitarian trend of modern times is the ever-increasing interest in the intoxications and diseases coincident with various trades. The ill effect that arsenic, lead, and phosphorus has upon its workers started this line of investigation, and these intoxications have been so well studied that their clinical pictures are clearly fixed in the mind of every physician. Undoubtedly the most serious and permanent of trade diseases are those which affect the nervous system. It is hardly necessary to go into details here of the various nerve poisons to which workmen are exposed, but a reminder of the portions of the nervous system affected may not be out of place. The peripheral nervous system is the one most often involved, and it is here that diagnosis is simplest. Lead and arsenic give most of our causes of occupation neuritis, but they are not the only ones. Copper, mercury, phosphorus, carbon bisulphide, aniline oil, and the cyanides have been known to give the same bad results. Of industrial poisons affecting the central nervous system much less is known. Besides lead, which affects, principally, the vessels of the brain, and so causes nervous symptoms, practically nothing is known. The ultimate pathology of most of the central nervous-system diseases is still unknown to us, and so one may easily speculate on causes of central nervous-system symptoms.

In the cases I will report here one is brought face to face with the possibility of the selective central nervous-system poisoning arising in metallic workers. The clinical picture, while confusing, is not altogether unknown in certain metallic workers. In its causation one has to look toward mineral substances formerly considered safe and harmless. Zinc has been extensively used by man since earliest times, and, by practically all authors, has been considered innocuous to the human system, if one may exclude the irritating effects on the gastro-intestinal tract, which all the heavy metals possess in common. Of manganese much less is known, as its use is far less extensive. The question I would raise before you now is, Can these substances cause a specific nervous system intoxication under proper conditions?

The cases presented here came under the author's observation among some workers in the separating mill connected with a large mine, from which zinc is the principal product In order to make the genesis of this condition clear a description of the materials, methods, and working conditions is necessary.

Eighty-five different ores are found in this mine. One ore. a sesquioxide of zinc. iron, and manganese, makes up 45 per cent of the bulk of the ore body. Willimite, a silicious oxide of zinc, forms 21 per cent. Rodenite, a silicate of manganese, 9 per cent, and the red oxide of zinc 4 per cent. The other 81 ores make up the remaining 21 per cent in varying quantities. Lead and arsenic may be absolutely excluded as causative agents. No trace of arsenic is ever found in the ore. Minute, indeterminable traces of lead are occasionally found in the routine analyses. That lead may be absolutely excluded becomes apparent when we consider that the first grade of commercial zinc must assay less than one four-hundredth of 1 per cent of lead. The zinc recovered from this mine is always first grade, and no measures are ever necessary to remove the lead.

The ore, as it comes from the mine, is run through crushers, after crude lumps of limestone and other foreign matter have been removed by hand, and, with screens, is divided into eight different sizes, varying from 0.074 to 0.020 inch. Each size then goes to a separate set of electric separators. These separators are what are said to be the strongest electromagnets in the country. There are 32 of these separators, in all, in the mill, and each one consists of 6 electromagnets which vary in strength, according to the size of the ore used. The weakest contains 20,000 ampere turns, and the strongest, 100,000 ampere turns. The ground ore, varying in size from a coarse sand to a fine powder on the different separators, then passes under the magnets on belts, and the magnetic ores—i. e., those containing iron and manganese—are picked off by belts running over the face of the magnets, and deposited in bins. The rest of the ore then drops to the floor below, and the zinc silicate and red oxid are separated from the impurities by a specific gravity method. The electric separation is done with the ore thoroughly dried and the specific gravity method is done under water.

As most of the handling of the ground ore is done in the dry state the dust problem has been one of much concern. The mine authorities have taken many ingenious means to reduce the amount of dust in the mill, and have eliminated a great deal of it. Nevertheless, throughout the mill, except on the floor where the water separation is done, the air which the workmen breathe is laden with a very fine gray dust, so that the atmosphere looks like a rather dense fog. In this mineral fog the men work in long shifts, and at the end of their day they are thickly coated with dust. A well-appointed washhouse adjoins the mill, in which the men may take a full shower bath, and change their clothes, before leaving for their homes. It is probably due to these precautions that cases such as I report are so rare.

The material for this paper consists of nine cases occurring in men working in this mill, and nearly all of them acquired the condition while working in, or shortly after being transferred from, the part of the building where the electric separators are situated. The history is practically the same in all cases.

After the man has worked in the dust for a length of time, varying from six months to three years, he begins to notice that he has difficulty in walking, the main feature of which is that the patient is unable to walk downhill slowly. On a level ground and uphill he has no trouble, but when he once starts to walk down an incline he gets going faster and faster until at length he must run to keep himself from falling on his face. He is unable to stop, and must keep on with ever-increasing speed until he runs against some object which stops him, or he falls down. This propulsion gait is accompanied by a very marked tendency to retropulsion, and the patient finds that he can not walk backward at all without immediately falling. Such was the history of the onset in all of our nine cases. With the onset, pain and stiffness in the legs were noticed in four cases, insomnia in one, and difficulty in writing in one. This patient complained that he could not well control his hand in writing, and that the figures he made were smaller than those he used to make. This is similar to the difficulty in writing which occurs in paralysis agitans.

While the symptoms of this condition are few, they are, nevertheless, very definite. The patient complains of very little except of propulsion, retropulsion, and unsteady station. The eyes are normal in every respect, and about half of the cases have very defective hearing, not due to middle-ear disease. The speech is slightly slurring in some cases. The face, in all the men, has somewhat of the flat, masklike character of paralysis agitans. There is more or less tendency to impulsive laughter. Tremor of the tongue is common, as is also a fine static tremor of the hands. There is never any rest tremor. The deep and superficial muscle reflexes are all active and equal. The legs feel weak and shaky, and the station is insecure. Propulsion and retropulsion in the gait are the most characteristic features. Asynergia is always present in the well-developed cases. The laboratory offers us very little aid in the diagnosis. The blood never shows the changes so characteristically seen in lead poisoning. The urine is negative in those cases we have investigated. The presence of zinc and manganese in the urine of workers will be spoken of later. Wassermann reaction was done on the serum of five of the cases, with negative results in all. The spinal fluid was examined in three, with negative findings. On the mental side, nothing characteristic is found. One patient showed a definite intelligence deterioration very similar to general paresis. Two others complained of difficulty in memory and attention, which was not demonstrable objectively. Most of these patients come from a class with little or no education which, combined with a language difficulty, has made routine mental examination very difficult. Nevertheless, it is safe to say that there is no definite mental side to this clinical picture.

Time will not permit of a full report of all the cases we have investigated, and one must be content with a full report of one which was studied in the New York Neurological Institute:

R. B., 49 years old, born in England, married. Was admitted to the third division of the New York Neurological Institute on March 11, 1912. His family history was negative in every respect. His early history was uneventful. He denied syphilitic infection. Pneumonia in 1893. He has been married 28 years, and has had three children, all living and well.

He went to work in this mill, as a shift boss on the electric separators, in 1902, and in the latter part of 1904 he began to have trouble in sleeping, and would tire very easily. In December of that year he began to lose control of his hand in writing. The letters he made looked small and cramped. He was unable to make the figure 3. It would take him a long time to write out his reports, and they were not clearly legible. At about the same time he became unsteady on his feet, and had difficulty in walking downhill. When he started to walk downhill, he would get going faster and, finally, had to run until he could catch hold of a tree or similar object. Every time he tried to walk backward, he fell; he had no sphincter trouble. In March, 1905, he left the mill, on account of the trouble with his legs, and of the fact that he was coughing up large quantities of black matter. He continued to cough up much of this black sputum for one and one-half years after leaving the mill. For the first year that he was away from the mill his symptoms gradually progressed until he was almost unable to walk. His speech became affected, and his family had difficulty in understanding him. He stayed in this condition until the spring of 1909, when he began to improve a little. He became more steady on his feet, and his speech was more distinct. He has progressed very slowly since that time. At present, he gets around fairly well with the aid of a cane. He can not walk backward or go downhill without falling. His speech is not entirely clear, his writing is still small and cramped, and his memory is perfect; sexual power was preserved.

Physical examination showed a fairly well-developed man of 49 years, weighing 141 pounds. His face was somewhat masklike and expressionless, and he was unable to whistle. The eyes were entirely negative, except for a corneal scar in the right eye, resulting from an old injury with the iris healed in it. Dr. E. B. Dench made the following report on his ears: "The reactions of the labyrinth on each side and of each auditory nerve are normal. There was only an insignificant middle-ear condition. I should, therefore, place the auditory impairment in the reception center."

There was a fine intention tremor of the hands. All deep and superficial reflexes were active and equal. There was no Babinski or clonus. He showed a tendency to propulsion in his gait, which became marked when he went down an incline. He was unable to walk backward without falling. Asynergia was marked in all tests. No ataxia. The electrical reactions of the muscles of the arms and legs were normal in every respect. Sensation was perfectly preserved throughout.

The lungs and heart were negative, blood vessels soft, blood pressure 126 to 140 millimeters. Analysis of the stomach contents showed slight subacidity. The urine showed nothing abnormal except a considerable excess of indican. The blood was normal. No anemia, hyperleucocytosis, or changes in the differential count. Wassermann reaction of the blood serum was negative. The spinal fluid showed the following: Wassermann negative; globulin content normal; cells 3 lymph. per cubic millimeter; Fehling's reduction positive.

The course of the condition is chronic. None of the patients has gotten well. Most of them improve when removed from the dust, and especially from the magnet floor. Three patients have made very little or no improvement. The duration is a matter of years. The condition is never fatal, but the prognosis for recovery is extremely poor.

Only one of our cases has come to autopsy. He showed the symptoms in rather marked form, and died of pneumonia. I am very sorry not to be able to report the findings in full, but the material is not as yet ready for sectioning. Grossly, the brain and cord showed nothing abnormal. There was no arteriosclerosis of the larger vessels or any areas of softening. From rather superficial inspection of the brain stem blocks before embedding, it would appear that the perivascular spaces of the lenticular nuclei and the outer part of the optic thalami are considerably larger than normal. These are not unlike the "launæ" described by Marie in certain cases of cerebral arteriosclerosis. These are only mentioned in passing, as the author does not at present care to lay too much stress on them as of pathological importance. No gross tract degenerations were seen anywhere. There were no gross changes in the kidneys, liver, or spleen.

We feel that this series of peculiarly similar cases represent a definite disease picture, the cause for which must be found in the working conditions or the material which the men handle. It has been a problem to determine the real causative factor. Zinc, of course, was the one first thought of, but zinc has been regarded for years as a harmless metal in so far as its effects on the nervous system is concerned. Popoff[1] described a case of general muscular atrophy, with gastro-intestinal symptoms, in a bronze worker, which he ascribed to zinc, but it does not correspond with our cases. Tanquerel des Planches[2] considers that zinc never causes any symptoms. Edsall,[3] with an extended experience among zinc workers, believes that zinc never causes a systemic poisoning. Schlockow,[4] in 1879, reported a peculiar disease which he had observed among some workers in a zinc mine in upper Silesia. The symptoms these patients exhibited were very similar, in many respects, to the ones we are considering here. There was marked intention tremor, but the most prominent symptom was gait disturbances, which he described as "stiff, hurried, and unsteady." Asynergia was certainly present. The reflexes were normal. The author considered it a disease of the spinal cord, due to zinc poisoning, although he had no autopsy material to substantiate his theory.

It is interesting to note that the ore taken from this mine in Silesia was not unlike that which our patients handled, in that it contained a considerable quantity of manganese, but there was also lead and arsenic in this ore, which possibly accounted for some of the symptoms Schlockow reported.

Feeling that zinc could not be blamed for this intoxication, one must next turn to the other principal metallic substance, manganese. The toxicology of this metal is little known, owing to its restricted use. Of all disease pictures reported in literature, none more clearly resembles the cases here presented than does that reported by Embden[5] in workers in a manganese dioxide grinding mill. He reported four cases which occurred in men who worked in an atmosphere of manganese dioxide dust. They showed general muscular weakness, but no atrophy; masklike face, with inability to whistle. The gait was unsteady and there was a tendency to fall forward, especially on going down an incline. Retropulsion was marked. All tendon reflexes were active and equal. There was a coarse intention tremor which in some cases made writing difficult. Voice was slow, unsteady, and monotonous. One case had impulsive laughter. There was no sphincter trouble. Manganese was found in the urine. These symptoms came on after the patients had worked a few months in the manganese dust.

It has been suggested that possibly the high power electromagnets among which most of these men have worked might play some part in the etiology of the condition. It is difficult to conceive of this as a primary cause, as there are other places where men work in high-power electric fields in which such a condition must have been observed long ago. However, when one considers that all but one of our patients developed the symptoms while working on the floor with the magnets, it must be admitted that possibly this factor plays an etiological rôle.

A final word on the absorption and excretion of the poison. Absorption takes place probably through the lungs. The density of the air dust makes it impossible to avoid getting the dust into the lungs. In all the cases there was a history of spitting up of dark sputum long after the patient had stopped working in the mill.

The fact that gastrointestinal symptoms did not occur in our cases probably excludes the absorption of the poison in this way. Of the excretion I regret that so little is known. The excretion of most mineral poisons takes place principally through the intestines, with the kidneys as a secondary channel. On one occasion specimens of urine were taken from four men working on the magnetic machine, none of whom showed any symptoms, and in each of the specimens definite traces of zinc and manganese were found. Four urines from other workers in the mill were analyzed and showed no trace of the metals. It was suggested that possibly in the magnetic field the manganese molecule was so altered that its solubility was increased. To determine this experiments have been made by shaking up the manganese bearing ore in rabbit's blood serum, both in the magnetic field and out of it. No difference in the solubility could be determined. To speculate on the question of why so few of the men employed in the work developed this condition takes one into the field of individual susceptibility, and thus far from the purpose of this paper. The conclusions the writer wishes to draw from this paper are:

1. That this is a definite pathological condition, recognizable by a definite symptom complex.
2. That it is a pathological condition of the central nervous system, affecting principally the mechanism of walking and equilibrium.
3. That it can not be placed under the heading of any known central nervous system disease.
4. That it is of toxic origin and, in greatest probability, the toxic agent is manganese.

DISCUSSION.

Sir Thomas Oliver regarded Dr. Casamajor's paper as one of a highly educational character. Like the reader of the paper, he took the view that the symptoms were due to manganese. Zinc is not known to give rise to any such symptoms as those recorded. It was interesting to observe that the lesion in manganese poisoning, if any existed at all, was in the spinal cord. The very fact that a patient during life had cerebro spinal symptoms suggests a toxic origin, even in a case where no anatomical changes are found at autopsy. Even in these cases, careful microscopical examination might reveal changes in the protoplasm and the position of the nucleus in the large multipolar cells of the central nervous system. It was interesting to observe that in the urine of the workers manganese was found only very occasionally. Although the dust entered the body by the respiratory channels, it was yet a fact, as Saito, a Japanese, had shown, that the bulk of the dust was found in the alimentary canal.

Dr. H. M. Harvey asked the number of men employed in the mine. Length of time in operation before the first case was observed. In what length of time did the mine cases develop. What methods were adopted, or recommendations made, to prevent this condition.

Dr. de Pulligny inquired whether this ore of zinc does not contain a rather high proportion of other toxic metals such as lead, arsenic, or even cadmium, to which the accidents observed could be attributed. The toxicity of zinc itself is generally questioned by the hygienists of the old world.

Dr. Louis Casamajor. I want to say that we have computed that about 2½ per cent of the men employed in the mill, for a period of over six months, in the last six years, have developed this condition. The condition was not recognized as due to poisoning until one year ago. Previous to this, the foremen in the mill had noticed that some men were unsteady on their feet. They would go along with a wheelbarrow all right, until they put it down, and then they would fall into it. One case was seen by a New York neurologist who said he did not know what it was. As the condition was not recognized before, no measures for prevention have been taken till lately. Now some of the men are wearing masks. If necessary the methods will be so changed that dust will be avoided.

I wish to thank Sir Thomas Oliver for his helpful remarks. There were no peripheral nerve symptom in any of our cases, except possibly the pains in the legs seen in a few of our patients.

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[1] Popoff: "Ein Fall von chronischer Vergiftung mit Zinkoxyddämpher und Experimente über die Wirkung einiger Antifermentative Mittel." Berlin Klin. Wochen., 1873, p. 49.

[2] Tanquerel des Planches: "Contribution a l'etude des intoxications professionelles." Thésé de Paris, 1902.

[3] Edsall: Article in Osler's Modern Medicine, p. 138.

[4] Schlockow: "Ueber ein eigenartiges Rücken-marksleiden die Zinkhüttenarbeiter." Deutsch med. Wochen., 1879, p. 208.

[5] Embden: "Zur Kenntniss der Metallischen Vergiften.—Ueber die chronischen Manganvergiftung der Braunsteinmüller." Deutsch med. Wochen., 1901, p. 795.

EYESTRAIN AND OCCUPATIONAL DISEASE.

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In 1910 the Census Bureau issued a classified list of occupations containing 410 pages. Duplicates and repeaters deducted, there remain "7,000 or 8,000 separate and distinct occupations." Classifications according to morbidity and mortality rates are therefore, for deducing lessons, almost impossible. One is lost in wonder at the recent unparalleled increase of new callings and of their ever-variant disease-breeding conditions.

Another glimpse of the same difficulty is given in the statistics of 120 general labor organizations and national unions in the United States. These, approximately, have 27,000 local unions, 4 departments, 39 State branches, 632 city central unions, and 668 local unions, all with a paid membership of about 2,000,000. The trade unions of Great Britain have a membership of more than 2,000,000 and an income in 1910 of $15,511,555. But the unions, of course, omit altogether the great masses of the country's population, so that, as a basis for judging the relative pathogenic rôles of the occupational conditions as a whole, we are without adequate data.

I have therefore, tentatively and crudely, grouped modern workers, union and nonunion, in such a way that we may roughly estimate the comparative incidence of a single pathogenic factor according to the nature and conditions of the labor. The five groupings of occupations are designed to indicate their rôles in creating or increasing the diseases directly or indirectly the result of eyestrain.

With one condition (later explained) in mind, the least eyestrain will, as a rule, be found in those workers of Group I, the most in those of Group V. From No. 1 to No. 114 eyestrain reflexes and diseases will generally be found to increase pari passu. The most common mistake of physicians and investigators is to forget the old fable of "the belly and its members," or the unity of the organism and the interdependence of its individual parts and organs. Hence the thousandfold and daily repeated error of considering symptoms manifested in one organ, as if it were independent and solely affected, while the cause of the disturbance really lies in some distant organ. Just as a poison in one part of the body morbidizes all other parts, as a lesion in a distant nerve or ganglion may affect a far and unlike organ and function, so may malfunction of the eyeballs beget disease in brain, stomach, spinal column—wherever, indeed, errant neural forces come into relation with movement or the world of circumstance and demand. It is an old fashion to ignore this old truth, but the fashion must change if our philanthropy is to be made real love of men and if our science is to be made really scientific.

GROUP I.

[40 per cent of population; 1 to 20 per cent have ocular or eyestrain diseases.]

1. Hunters, trappers.
2. Lumbermen, raftsmen.
3. Fishermen, oystermen.
4. Seamen, sailors, marines, Navy.
5. Ranchmen, herders, drovers, stock raisers.
6. Farmers, agricultural laborers, fruit raisers.
7. Common laborers, road and street makers.
8. Soldiers.
9. Teamsters, draymen, hackmen, hostlers, hucksters.
10. Policemen, watchmen.
11. Street-railway employees.
12. Foremen, overseers.
13. Gardeners, florists.
14. Packers of meats, fruits.
15. Switchmen.
16. Hod carriers, building and construction workers.
17. Railway trainmen, carmen, freight handlers.
18. Stationary engineers and firemen.
19. Quarrymen, ore men.
20. Locomotive firemen.
21. Locomotive engineers.

GROUP II.

[10 per cent of population; 20 to 40 per cent have ocular or eyestrain diseases.]

22. Sugar makers and refiners.
23. Hotel and restaurant employees and waiters.
24. Engineers (civil, mechanical, electrical), surveyors.
25. Railway conductors.
26. Domestic servants, cooks.
27. Laundry workers.
28. Roofers (composition, slate, tile).
29. Billposters.
30. Painters (outside).
31. Brick and terra-cotta workers.
32. Pottery and tile workmen.
33. Asbestos workmen.
34. Brewery employees.
35. Stage employees.
36. Butchers, meat cutters.
37. Pulp, sulphite, and paper workers.
38. Steel-plate transferers.
39. Marble workers.
40. Carriage and wagon makers.
41. Piano and organ workmen.
42. Woodworkers, curtain makers.
43. Carpenters, joiners, car makers, pattern makers.
44. Cement workers.
45. Merchants, salesmen, saleswomen.

Group III.

[10 per cent of population; 40 to 60 per cent have ocular or eyestrain diseases.]

46. Masons, stonecutters, bricklayers.
47. Printing pressmen, lithographic press folders, stereotypers, color mixers.
48. Plumbers, gas fitters, steam and hot-water fitters.
49. Machinists.
50. Painters (inside), decorators, paperhangers.
51. Lathers and plasterers.
52. Coopers.
53. Molders, foundry men, tin-plate workers.
54. Bridge, structural iron, steel, and tin workers.
55. Metal workers, iron-ship makers.
56. Blacksmiths, horseshoers.
57. Lead and zinc workers.
58. Paper makers.

Group IV.

[20 per cent of population; 60 to 80 per cent have ocular or eyestrain diseases.]

59. Housewives.
60. Professional invalids, asylum and sanitarium residents.
61. Bakers and confectionery makers.
62. Electrical workers.
63. Brush makers.
64. Hat and cap makers.
65. Boot, shoe, and leather goods workers.
66. Actors and actresses.
67. Upholsterers.
68. Glove makers.
69. Spinners, weavers, textile workers.
70. Saw smiths.
71. Garment makers.
72. Metal grinders, polishers, finishers.
73. Bookbinders.
74. Basket makers.
75. Tool and cutlery workers.
76. Pupils of public and private schools, below high school
77. Chemists, laboratory workers.
78. Musicians.
79. Telegraphers.
80. Boiler makers.
81. Broom makers.
82. Miners (coal, mineral).
83. Tunnel and subway workmen.
84. Compressed air and foundation workmen.

Group V.

[20 per cent of population; 80 to 100 per cent have ocular or eyestrain diseases.]

85. Students of high schools, seminaries, colleges, universities.
86. Clergymen.
87. Lawyers.

88. Bank clerks.
89. Lathe workers.
90. Clerks (commercial, post office, railway).
91. Wood carvers, lithographers.
92. Journalists, reporters.
93. Authors, literary and scientific workers.
94. Professors, teachers.
95. Barbers.
96. Stenographers, typewriters.
97. Draftsmen, designers, architects.
98. Physicians and nurses.
99. Artificial-flower makers.
100. Jewelry makers.
101. Bookkeepers, copyists.
102. Dentists.
103. Watch and clock makers.
104. Telephonists.
105. Engravers and photoengravers.
106. Cigar makers.
107. Glass blowers.
108. Sewing women and men, dressmakers, tailors.
109. Lace and embroidery workers.
110. Typesetters.
111. Cutting die and cutter.
112. Miniature painters.
113. Photograph retouchers.
114. Etchers.

The groups and the order given the occupations within a group have the value only of my guesses, made up from personal experiences with patients, supplemented by reading, and individual knowledge of medicine, industries, and life. The large percentage of the total population placed in Group I appears justified by the inclusion of the great masses classed as farmers, agricultural laborers, common laborers, soldiers, railway workmen. The school children and housewives greatly increase the total comprising Group IV.

Assignment of a person to a group, or to a particular place in a group, depends upon a number of considerations, the chief being—

1. The average distance from the eyes of the object habitually observed, and its size—the nearer it is, and the more minute, the greater the eyestrain.

2. The more constant this near focalization, the more severe the eyestrain.

3. With decrease of the illumination below a high physiological standard there is a geometrical increase of eyestrain.

4. The exposure of the eyes, during labor, to wind, cold, heat, dust, excessive illumination, and so forth, heightens their liability to inflammatory diseases, and also to eyestrain and its systemic reflexes.

5. In near work, such as reading, writing, and the like, an habitual abnormal position of the head or of the body may add enormously to the occular injuries and eyestrain.

6. The age of the workman may govern the degree of eyestrain. Without correcting spectacles, everyone has eyestrain after 43 years of age, especially in looking at objects persistently within "near range," i. e., at reading, writing, and handwork distances.

7. The synchronous cooperation of the two eyes is also an important factor. By mid-life, because of anisometropia, heterophoria, and so forth, one eye is often disused, amblyopic, or even blind. This trend emphasizes dominancy of one eye, so that this lessens eyestrain, which is the cause of the disuse of one of the eyes, but at the same time it adds to the liability of accident from the blind side, and also multiplies the dangers and handicaps of the worker in other respects.

8. Probably 6 per cent of children are naturally left-handed, left-eyedness causing left-handedness. The unconscious crime of trying to make a left-handed child into a right-handed one produces tragedy in the life. Many causes may also transfer the dominance of the coordinating eye over to the other eye, thus exposing the unfortunate person to many trials and dangers.

9. A peculiar axis of astigmatism, or the writing posture, may so cant the head and body to one side as to set up lateral spinal curvature, and bring the child to death's door because of vomiting, denutrition, and so forth. Correction of the refraction errors and the morbid posture in such cases would bring health. From 6 to 10 years of age many children show an incomprehensible "nervousness," chorea, fickle appetite, and various disorders, all usually due to eyestrain.

10. There is one qualification as to the constancy of the groupings, which, omitted, would confuse the investigator. It is the unsuspected eyestrain work which may be indulged in besides that of the occupational demand. A member of Group I, for instance, may be ruining eyes and health by novel reading, study, sewing, embroidery, or games carried on at night or during rainy or unseasonable weather. The light used may also be poor, and unshaded in front of the eyes. The habits must be studied to learn the truth about each individual worker and his proper placing in one group or another. I have known of hundreds of patients with health nearly or wholly ruined by eyestrain, who, by order of their physicians, and face to the light, were reading without spectacles and lying down, too, for many hours a day or so long as outraged nature would permit. Their diseases were thus increased by order of the hospital or sanitarium. The very latest reported cure for the diseases of eyestrain is knitting in bed without glasses, or with such as increase eyestrain, for six hours a day. The order should also have been "with one-half normal illumination."

Moreover, in patients with high refractive errors, unsymmetric astigmatism, or anisometropia, even distance vision is pathogenic.

11. It should also be added that the morbid results of eyestrain, never wholly absent throughout life, may begin very early in childhood, even in the second year. Many little children, for instance, are constantly tearing their clothes, hurting their feet and legs, stumbling, and falling, because their eyes are so faulty that the estimates of the size, location, and nature of objects, are not correctly made, and the proper muscular coordinations are so inaccurate that motility is erroneous and unsafe. Adults hitherto blind and suddenly given good vision, require years to learn to see with accuracy or safety in action.

Eyestrain is an unfortunate word, but we are compelled to use it. It is usually misunderstood to mean the overuse of a pair of optically perfect eyes. It should be defined as that use of ametropic eyes which is pathogenic, or productive of local or systemic disease. But measurements of human eyes demonstrate that there is not, probably, one pair in the world absolutely emmetropic. That would be a miracle which nature with all her infinite ingenuity has never performed. No human face, indeed, of the world's sixteen hundred million may be held perfect, either artistically or physiologically. To the owner of the face that is relatively an unimportant matter, but to the owner of the pair of eyes an error of one three-hundredth of an inch in the curvature or dimensions of the eyeballs may make their all-important function pathological, may even invalidate or end the life of the man or woman.

The highest differentiated of tissues of the human organism is the brain, and genetically the eye is the only organ made directly from cerebral tissue. The brain literally comes out of the skull in order to see. The eye responds to the smallest physical force in the world—that is, light waves are hundreds of millions of millions of times more infinitesimal than sound waves. The eyes are the hardest worked of all organs. The safety and existence of human lives frequently depend directly upon their accurate function, i. e., upon nonpathogenic action. All organismal motility is conditioned upon mathematically exact coordination with and dominance of vision in the motions and localizations of the hands and the feet, of external and distant objects. Ubi motus, ibi visus! The perfection of visual function requisite in civilized occupations of infinite variety and differentiation is thus seen to be necessarily wanting in some way or at some time of life. The startling truth comes to better recognition when we realize that in the past the entire complicated mechanism of vision was made and used almost solely for distant vision, while for the majority of its expert and educated workers modern civilization chiefly and increasingly demands constant and accurate vision at near range. For this the mechanism does not exist, and the attempt to compel the function brings disease. Nothing of like importance is so appallingly neglected by medicine and hygiene.

This strange and unscientific neglect is explainable by the failure of investigators and physicians to recognize two physiological truths: Nature can not keep a muscle continuously innervated or contracted, and she can not keep a retina continuously sensitized during any protracted exhaustion by the image stimulus. Of the ciliary muscle of the eye, and for most of the working day, modern tasks command almost continuous innervation and contraction. So exigent is the taskmaster that the eyes are put to impossible tasks, from which result, first, local inflammation and morbidities of the lids, conjunctiva, and so forth, and, later, retinal congestions, myopia, iritis, cataract, and so on. Worse even than these are the systemic ocular reflexes, the morbid overflows and reactions of the cerebral telegraphic switchboard. There is a long list of these cerebral and mental diseases, the vast majority not caused by organic disease of the brain, and due solely to the morbid reflexes of eyestrain—"nervousness," tics, choreas, neurasthenias, epilepsies, and especially the interminable list of headaches and migraines—with or without giddiness, swoonings, or faintings; exhaustion and morbid psychic effects; diseases of memory, such as losses of self-knowledge and subsequent findings of self far away with sudden coming back of memory; so-called Meniere's disease; the functional stomachal and digestional diseases with persistent vomiting, anemia, denutrition, and so forth. Lastly, to swell and complicate the horror, between 80 and 90 per cent of the school educated have lateral spinal curvature, which is largely of ocular origin.

All these amazing sins of unhygiene are almost wholly preventable by two simple devices—by scientific spectacle lenses and by physiological posture of the head and body, especially during writing, study, and like occupations. This correct posture may only and chiefly be secured by the sharply slanted school-desk leaf and proper position of the writing page and book and the correct placing of the hand. The spectacles may be obtained only by great scientific care, and when science and philanthropy are united. The morbidity rate will then be several times reduced and the mortality rate at least halved.

Although the order of the groups was not designed to illustrate one thing, it nevertheless does make manifest a noteworthy fact: The production of eyestrain by recent civilization. The first group includes most of those occupations dominant before the invention of printing. In the last group they are almost solely made up of the most differentiated or specialized callings of the latest civilization required by learning, literature, printing, sewing, telephoning, and their ancillary crafts. Intimately correlated is the fact of urbanization. Eyestrain increases pari passu with work at near range—i. e., according to the amount of work done inside of houses—and the modern growth of population is largely taken up by the town and city. Some part of this evil is offset by the invention and popular use, in the last few years, of glass windows—the greatest of all discoveries as regards health. And almost as valuable is the better artificial illumination of our time. The rush lights, lard lamps, and tallow dips of our forefathers and foremothers were prolific sources of ruined eyes and health. In India to-day cataract is for this reason vastly more prevalent than with us.

Civilization thus necessarily lessens the numbers in the lower or first groups. All civilization depends upon increased use of the eyes at near range. Group V is thus steadily absorbing the members of the lower groups. There are, indeed, a small number in Groups IV and V who are really going back to preceding groups by a sort of vicarious atonement. For instance, heads of business enterprises and of various institutions, and many professional men, now employ stenographers, research workers, clerks, copyists, even authors and bookmakers. These come up from lower groups, and take upon themselves the ocular reflexes of their employers. Machinery is also lessening the number of employees of the first four groups, and, in the differentiation of function and systematization of many businesses, the same fact appears. Urbanization itself increases the number of sedentary or eye-straining occupations. The school children and students, with the sharp general increase of the number of the educated, coupled with the amazingly vast output of the printing press—these and various other similar habits add to the evil.

The great truth I am seeking to bring into evidence is that civilization itself is the direct and indirect product of vision—its absolute sine qua non. Language, the very letters of the world's one alphabet, memory, the processes of sensation and of thinking—crede Bergson—the existence of science—whatever elements of modern life are basic, all are the products of picturings and the epitomes of images, systematizations, and utilizations of the acts of vision. Every advance in civilization is dependent upon greater precision and increased strain in near-range vision. There is thus the progressive moving up of the members of each group from the lower to the higher, and a rapid increase of the percentage of Group V. The added fact that, in the vertebrata, all useful actions, all motilities, all muscular actions and coordinations, have depended upon vision—vision, both as incitor and director—shows that the whole fact and course of animalian and human evolution has been dependent upon vision, and is largely the product of vision. The exclusion of the unfit and the survival of the fit has been and is rigidly conditioned upon the inheritance of the best eyes and the highest accuracy of function of the eyes. It should be recognized that the pathological functioning of an organ has for the organism the equivalent of ill which its physiologic function has for good, or for service. The pathology, i. e., the ill health of civilization is, in truth, largely due to the pathology of vision. Learning to see, and to coordinate vision and muscular action with precision and lightning-like rapidity, require a long and difficult apprenticeship. It absorbs at least a dozen years of the child's life. If handicapped by ametropia, the result is never good; with many defects, it is so imperfect that it begets constant pathologic results to both eyes and organism. As to the millions of common school children, their ocular ills, their eyestrain, and its effect upon general health, their standing in classes, the reasons for the dullards and truants, and even juvenile criminals—of all this big book of human ills and wrong, we are now at the opening page. The headings of the chapters on lefthandedness, spinal curvature, and the writing posture have been written, but not one good school desk exists in the United States, and every child writes with body and head and eyes in disease-producing postures.

There are three sources of sickness. Either the workman's body or mind brings it with him or his job and its conditions supply it; or, lastly, it is due to far-coming infection. We now know that the seed—infection—is of comparatively little power or significance without the conditioning and prepared soil. The latest word, moreover, of medical science—immunity, or immunology—shows that the best way to meet infection is by the inherent and strengthened ingenuity of wise life to fight the invading foe in her own sacred home and country. We are thus practically limited to two sources of our morbidities. Disease is either brought to his occupation in the body of the worker or the occupational conditions beget it. As scientists and hygienists, we exist for the prevention of disease.

But in its early stages the ontogeny is simply the epitomized result of phylogenetic action and reaction in the infinite evolutionary past, and it is therefore but little subject to the temporary influence of individual therapeutic effort. Moreover, the later the parental links of the phylum the less this modificatory power over the ontogeny. Effective therapeutics therefore resolves itself almost wholly into late and cumulative ontogenetic modifications and resistances following environmental changes. Whether these characters are called "acquired" or not, and whatever may be the definition of "acquired," matters naught to one who fixes his attention upon real facts and effective function, instead of upon theories and definitions. The thought which brings clearness into the discussion is this: The longer the phylogenetic history and the more differentiated the ontogenetic tissues the less the reaction to and modification by circumstances. The plant which, taken from low levels to mountain heights, lives by sudden and extensive modifications of structure, has little to teach the highly differentiated ontogeny called a man. He must prevent sickness and preserve life largely by the artificial helps of civilization and science, instead of by crude structural changes.

The conclusion thus becomes clear that environmental injuries may be prevented, neutralized, or overcome in three ways:

1. By our conscious and designed environmental changes made possible by civilization, through devices, new mechanisms, and controlled conditions. By experience and instruction the workman may be taught to avoid his reckless occupational poisonings; machine holing will bring miners' nystagmus to an end; glass blowers' cataract is unnecessary; most infectious and parasitic diseases are conquerable by hygiene, almost by simple cleanliness alone; poisonings by work in lead, brass, mercury, and so forth, may be easily avoided; eyestrain is prevented by scientific spectacles; and so on through the list. When once combined and in earnest, hygiene, civilization, and philanthropy will largely extinguish occupational disease by such protective modifications of conditions. Already the life length and health secured by modern clothing, housing, glass windows, artificial illumination, progressive farming, transportation, and so forth, have enormously added to the number of lives and to the average length of life of civilized peoples. The ametropic eyeball, e. g., can not be made emmetropic, but the ametropia may be neutralized by lately devised optical lenses.

2. By increasing, through artificial immunization, the natural or acquired resisting powers of the body against infection.

3. By slow and cumulative reactions, functional, cellular, or structural, foreseen by eugenics, against harmful environmental influences. This cumulative modifiability in phylogenetic development has been the mechanism of the origin of species and of filling the world with life.

The abiding result, either of simple observation or of the most inclusive scientific generalization, the one great miracle of all life, is this amazing success in the intelligent adaptation of long lines of inheriting organisms to an infinitely varied and continuously varying environment. These diverse life forms and the origins of species are simply illustrations that the origins of disease may finally be neutralized or overcome. This is the glory and the success of rational as distinguished from empirical therapeutics, the task of preventive instead of curative medicine. Pathogenesis being thus due to the failure of reaction of the organism, it follows that the occupation may be freed from its apparent morbific effects, either by the hygienic suggestions of the hurt organism, or by overcoming and preventing the hurts through its own self-evolved variations, obviations, adaptations, resistances, immunizations, and victories. Temporary sicknesses—functional diseases—are the passing failures of the organism to react successfully; organic and lethal diseases are the ingravescent failures or postponements of death; and death itself is the final acknowledgment of utter failure to react successfully.

What disease-breeding factors and powers does the worker bring to his occupation? It is self-evident that, except infections (and even here the organism supplies the most important help, the soil), all organic and lethal diseases (omitting the disease anno Domini, or utter senility), have their sources in abnormal or aberrant physiology. The pathology which is rational, and motived upon philanthropy, asks simply about the precedent pathogenic and curable functions that begot the incurable disease. They are the causes of the lethal diseases, death, as we have said, being the confession of the individual inability to adapt the organism to the environment. The command is, therefore, to stop the late and incurable diseases by the prevention and cure of the functional diseases. In eyestrain this is amazingly possible. Now, there are a hundred types of these preventable functional diseases. But their ultimate causes are not so many. Our world, for instance, is crazed and sickened by morbid habits, by alcohol, by tobacco, by sugar and candy, by luxury, by narcotics, by venereal disease, by pseudoliterature, by pseudoeducation, by egomania, by sin, by the lust for power and wealth, by concealed crime, by faddism, by monotonous drudgery, by diseases the prevention of which or the causes and cures of which are known but ignored, by hopeless poverty, by the haunting horrors of insanity, suicide, and approaching death. The chief and most prolific of the list is eyestrain, but its known rôle and certain prevention are sadly neglected.

Up to the present time the recognized occupational diseases of the eyes have been few in number, the etiologies indefinite or erroneous, the prevention and therapeutics either mere makeshifts or unknown. This was because the physiology of vision was not understood, the facts and causes of eyestrain unrecognized. Many years ago, for example, with little search, I found all about me large numbers of albinos. The results of the study of these cases were most inspiriting to me, but to nobody else. There may be 100,000 such patients, or should-be patients, in the United States. Their tragedy is solely ocular and wholly due to nonpigmentation of the irises. The whiteness of the hair has no significance. Because of the semitransparency of the irises, the entire retina is flooded with half light, and thus the image is not sharp or accurately delimited by shading. The retinal sensitiveness is so exhausted that great amblyopia follows, and, to find new and sensitive retinal areas, a constant nystagmus naturally replaces the steady fixation of the image upon the macula. It was an inevitable and saving way of making the best of a bad bargain. The palpebral aperture is also habitually narrowed in order to exclude the peripheral rays of light, and the cornea is thus crushed by the lids into enormous astigmatisms at axes 90°. The correction of the astigmatism, while not curing the chief cause of misery, would bring wonderful relief to the albino from the worst effect, and would multiply his abilities to overcome his pitiful industrial problems. Except as a farmer—and a poor one—he is now shut out of almost every ordinary calling. The poor image not bordered by darkness, which is the real source of the evils, could be stopped by early and constant use of colored or smoked toric lenses with small transparent ametropic lenses inserted in the centers.

The study of albinism would have taught the needed lesson as to the etiology of the nystagmus of the "holing" coal miner. Its cause is said to be due to the position of the body and head of the miner in holing and his looking upward.[1] I think this looking upward has little or nothing to do with the origin of the disease, because the nystagmus of the more numerous albinos could not be from such a nonexisting cause. I have watched miners at holing, and there was no looking upward, the horizontal body and head not possibly being lower than the point of impact of the pick. The real cause of the miner's nystagmus is, I think, the same as that of the child with anterior polar, or any central cataract. It consists of the insufficient and pathologic illumination of the retina by the object gazed at. The bare flame of the wretched lamp is also often in front of the eyes. There is also quick, tense closing of the lids to avoid corneal injuries by the darting bits of coal; this increases astigmatism, amblyopia, and eyestrain generally. The change to machine holing will end miner's nystagmus.

The cataract and the ocular diseases of glass blowers are explainable in similar and natural ways. As asserted by Halfort in 1845, ordinary or senile cataract is caused by eyestrain—that is, by ametropia and presbyopia—and is preventable by scientific spectacles. The glass blower subjects one of his eyes to great light and heat in looking through the furnace opening at the molten glass. His gaze at the glowing bulb also increases the corneal warping, the retinal and lenticular inflammation, ametropia, denutrition, with consequent loss of transparency of lens, and cornea. Properly ground and smoked or colored lenses (over the furnace opening also) would certainly prevent these evils. The ametropic correction, also united, would cure much or most of his "indigestion and dyspepsia," now charged up to "unhygienic food and habits," but in scores of other callings found to be due to eyestrain.

Even when the sources of some of the workman's diseases are more plainly due to poisons, almost all authorities continue to ignore the agency of eyestrain in producing or increasing symptoms which we now recognize are caused by eyestrain. Many writers seemingly have never heard of "asthenopia" (the ancient of eyestrain), much less of astigmatism. Others find that the action of dust has no relation to ocular disease; at least, it is ignored. Even needle-grinder's eyestrain to them suggests lung trouble only. The high-water mark is reached by one reporter who, in 1892, ridicules the idea that congestion of the choroid, asthenopia, cataract, and blepharitis may be caused by diamond cutting, jewelry making, and similar pursuits. He therefore applies to the senior surgeon of the local eye hospital of the city where engraving, jewelry making, fine metal work, and diamond cutting are extensively carried on. The ophthalmologist answers that the eye affections in these trade workers "are those in which some optical defect exists, especially hypermetropia and astigmatism." The workers suffer from diseases of the choroid, retina, conjunctiva, and lids. "But, in their case, it is not the work, but the unfitness of the eyes for the work, which is to blame." "On the whole, I should say that fine work, even when regular and persistent, does but little if any harm to normal eyes." Such hygiene finds that ill-ventilation accounts for the high mortality of typesetters and printers, and so forth, and so on. What is "a normal eye," and where is the emmetropia, which is wrongly taken for granted, the rule?

Most suggestive are the three reports concerning telephone operators issued in the United States, in Canada, and in England. There are in the United States about 125,000 telephone girls whose average term of service is three years or less. The working hours are about eight per diem; the average number of calls is about 140 per hour, running, "at the peak," to "the breaking point of efficiency," 225 or more. The Bell system seems to be trying to do its duty as regards the health of the girls, but there is no evidence that it has secured expert medical advice, and, especially, in ophthalmology, the most important of all. The company in 1911 spent $720,953 for rest rooms and lunch rooms for the operators, and it has secured sufficient air space and good illumination. Despite these things, it is a startling fact that, although only young and healthy girls are selected, the average length of service does not exceed three years, and may be less. The symptoms mentioned are headache, dullness, indigestion, exhaustion, nerve strain, insomnia at night, but with daytime sleepiness, colds, and so forth. Medical medievalism resurges in "blood surging to head and arms." Equally absurd is the emphasized nonsense that the effort of reaching upward and sideways "to plug in the farthest jacks of the switchboard constitutes the physical elements of strain." Fully as antique is the statement that "constant reaching to one side seems to increase spinal curvature." With this is to be read the fact that most of the reaching and hard work is with the right hand and arm, so that the woman with spinal curvature, "be it ever so slight," "should be kept out of telephone work." The etiology of lateral scoliosis is thus seen to be as unknown as its nature, its cure, or its prevention. The truth, of course, is that if the lumbar curve is to the right, reaching and bending to the right would lessen or even cure the disease—"be it ever so slight." Reaching upward, which is so diligently bemoaned, would surely be a hygienic blessing, be it ever so frequently done.

The intolerable fact that stares at one from every page of the United States report is that not the slightest hint is given that the two or three short years of telephone labor possible to the girls, and nine-tenths of all their awful suffering and wrecking, is due to constant near-range eyework without scientific spectacles. The demand —encouraged, to be sure—of the girls for "hot coffee," especially at night, is a pointing finger to the road down which millions are hurrying toward "the deep sea."

The report of the Royal Commission of Canada is somewhat more enlightening, because physicians from the University of Toronto were called to give their testimony as to the illness resulting from telephone operating. These gentlemen testify that the following facts, conditions, or diseases exist—I quote their words:

Reaching upward injuriously affects the nervous system.
Nervous debility.
Faces showed indications of weakness on account of strenuous employment.
Eye, ear, and throat all strained.
Nervous hysteria.
Constitution and nervous system injured.
Wearing down of the nervous system.
Optic and auditory nerves strained.
Debilitating to the nervous system.
Girls burn up more energy than they produce.
Most exhausting of all occupations.
Injurious to eyesight.
Produces headache looking at the holes.
Prevents rest.
Can not sleep when they go home.
Couldn't eat well.
Reaching is hard and injurious.
Eye troubles, headaches, and nervous troubles.
Affects the eyes, and, through the eyes, the general system.
The most trying of occupations.
Throat, chest, and nervous troubles, and headaches.
Nervous prostration and nervous breakdown.
After three years, unable to satisfactorily perform the ordinary occupations of womanhood.
Fainting.
Strain on nervous system through eye and ear.

Nerve fag.

Nervous exhaustion.

Strain upon the optic nerve and the muscles of the eyes.

Saw difficulty in fitting the plug in; they seemed to scrutinize it closely.

The nerves governing the extraocular muscles which focus the eye upon the object looked upon are the nerves where the greatest part of the strain comes.

Reaching added to the physical fatigue.

When they leave they turn out badly in their future domestic relations.

It is this sort of thing that is laying the foundations of the asylums, and it is dealing with the question now that will prevent the building of asylums and the loss of people to the community.

Not so much physical, as mental and nervous, and exhaustion of nervous energy, a depletion of nervous force.

The reason for such a marked increase in insanity and nervous prostration all over the country.

After five years she would be disqualified to become a wife and mother.

On future generations the effect will be epilepsy and all sorts of nervous diseases.

In other words, brave statements of facts and end results, with no recognition of the single cause, ametropia or eyestrain, from lack of scientific spectacles. In all households, in every occupation, in the thousands of hospitals, sanitariums, and homes, are millions of sufferers with the identical diseases, caused by near work without correcting glasses, in every and any occupation.

But there is here, at least, a glimpse that the numbo-jumbo, "fatigue," has a cause; that it has no significance per se; that it is not physical in nature, but nervous; and that it is not the fatal malevolence of the nature of things, beyond investigation and beyond thought of prevention, except by lessening the hours of labor. It must be so helpful to the laborer to tell him that he is fatigued, and that he must work only half the usual number of hours.

"Just as we are going to press," in the language of the happy editor, comes the English parliamentary report of the committee of medical officers concerning the condition of working of telephones. At last the discovery made by Halfort 67 years ago, rediscovered by Mitchell nearly 40 years ago, and again rediscovered by Savage 30 years ago, is once more being rediscovered to-day, and every day.

The English report does not say that the neurasthenia is caused by the work, but that this, with the anemia and neurotic tendencies, were brought to it by the worker. "Errors of refraction," it is stated, "became manifest by the nature of the work." The medical officers are advised to exclude candidates "showing pronounced signs of nervous instability or anemia, and of insuring that candidates suffering from hypermetropia and astigmatism have those defects corrected by proper glasses. The committee found that 142 out of 248 operators examined had had their health impaired by the "nerve and physical strain." "On a busy morning there is hysteria, as the girls get worked up," and the words "shivering and panting," "sobbing and crying" are used. "One girl fainted four or five times running." Another said, "Glow lamps are very trying to our eyes." "Dr. H. said that telegraphy got into my body (nerve storms); I used to twitch all over." One "thinks sight is affected by the boards being so close." "Miss ——— was on sick leave for three weeks from neuritis." "Switchboards are so close, great strain to eyes," testifies an operator. "Eczema of arm and abscess of ear." Such are some of the many items noted. The average annual sick-leave absences (London, Manchester, and Liverpool) steadily grew threefold in 10 years. In one year, the diseases listed in the sick room patients attended to were these, and in the following order: "Faintness, headache, indisposition, biliousness, hysteria, neuralgia, colds, and miscellaneous." The number of patients in the year, taken by months, March to March, were, respectively, 51, 106, 91, 103, 121, 146, 108, 107, 153, 140, 171, 138, 97, a total of 1,532. It is found that, generally speaking, the strain upon telegraphers and telephonists is about equal in degree. The disorders most frequently mentioned and most emphasized among the telephonists are "nervous affections, digestive disorders, anemia, nervousness, neurasthenia, nervous disorders, nervous debility, migrain, headaches, vertigo, palpitation, and so on, precisely those I have found in thousands of patients, and, for 20 or more years, have demonstrated to be due to eyestrain.

In Norway the report is that of 390 women there were in 1 year 11,621 days of sick absence, many because of diseases now recognized as due to eyestrain, distributed as follows:

Bronchitis, laryngitis, influenza	2,482
Gastritis, enteritis	2,324
Neurasthenia, cephalalgia	1,990
Anemia, circulatory, and blood troubles	1,705
Affections of sight	651

According to the English report, in Belgium the "physical conditions required for admission as telephonist" are peculiarly interesting, because they indicate some beginning glimmerings of recognition of truths concerning eyestrain. The principal duty of the Belgian examiner seems to be the long, exact, and useless "verification of the chromatic sense by Prof. Holmgren's method," ending with an accentuated "N. B.—Correct chromatic sense is not required of telephonists." However, "normal clearness of vision" is the chief requirement, and, mirabile dictu, "the test is applied to each eye," and "spectacles may be used in the tests." "A myopia of 6 D. may, at most, be allowed," if the visual acuteness is good; and hyperopic lenses "of any strength" are permitted on the same condition.

The report is a carefully guarded one, by silence or cautions refraining as much as possible from crediting illness to eyestrain, but the dawning truth looks out at one from between and behind the lines. Some other callings are certainly more health wrecking than that of the telephonists, those, e. g., followed by musical composers, literary workers, sewing women, and so forth. It is gratifying to know that a host of nervous and digestive disorders may soon be recognized as originating in eyestrain.

The trials of the telephone girls illustrate the eyestrain results of new callings of civilization. There are many such novel industries appearing. A friend assures me, for instance, that men who run elevators or lifts are subject to novel eyestrain diseases. Typewriters, retouchers of photographic plates, machine printers and rulers, and wall-paper printers may also be mentioned.

The fundamental principle in deciding questions of the interrelation of eyestrain and occupation was first stated by Adam Smith—the proportion that the number of workers bears to the number of nonworkers. This seems to concern the production of wealth alone. but in its implications and necessary extensions it warrants most important conclusions. For the ability to work, or the disability, means much, means everything, to the worker and his family. All these, moreover, who die too early or who are turned over to institutional or private charity to support for the rest of their lives, these of course are among Adam Smith's nonworkers. The students of occupational disease do not seem to have kept Adam Smith's statement in mind. The very death rate and length of life are still largely determined by morbidity or by loss of serviceable vision. The habits formed in the dark ages, when incapacity for work meant death, are still present. When presbyopia came at the ages of 42 and 43 the worker in many callings had to stop, and had soon to die. For six years, beginning at 43, there were 60,000 more deaths in 100,000,000 born than in the six preceding years. The pensioning systems of our times often only prolong the uselessness of old age and continue a preventable senility. Instead of establishing pensioning systems we should at least do what is easily possible, provide suitable and beneficent occupations for the superannuated. Despite sentimentalism and false charity, there is not a blind person, for instance, who can not earn, or be soon taught to earn, his own living and be the happier for it. Many blind mechanics are making good livings [2] in a hundred diverse callings, to the shame of "tin-cup men" and street beggars, if to these, indeed, shame were possible.

The oldest treatise I have found on the subject of industrial diseases is that of Halfort, published in 1845, and entitled "Enstehung, Verlauf, und Behandlung der Krankheiten der Künstler und Gewerbetriebungen." It is the first time that Artizans (whose labor is so greatly ocular) are thus emphasized as being so decidedly subject to occupational disease.

Concerning straining of the eyes in industries, the author speaks of the now forgotten truth that the eyes are the most delicately constructed and noble organs of the body; he emphasizes the reasons for such strain as follows:

1. By long-continuing looking at small objects, mentioning especially watchmakers, typesetters, embroiderers, lacemakers, miniature painters, manuscript copyists, engravers, and so forth.
2. Work with harsh colors, or upon highly illuminated objects.
3. Labor under poor or fluctuating illumination, such as by flickering oil or candle lights, and, if long continued, even with good lights.
4. Sudden change from darkness to light.

The diseases resulting from these abuses are thus listed:

1. Shortsightedness from work on minute objects.
2. Inflammation of the external parts of the eyes, and, later, of the internal parts, leading to loss of vision and cataract.
3. Visual deterioration, amaurosis, deep-seated pain of the eyes, more frequently intense headache.

Spectacles and hygienic precautions are recommended to obviate the foregoing ills. The nervous irritability of yarn spinners is emphasized. And there, forgotten or ignored, this wise old observer is left.

There are not a few encyclopedic and erudite epitomes of the subject of industrial ocular diseases. All the local ocular diseases of every class of workmen are set forth from many points of view. But what is of value to the physician and hygienist, profoundly solicitous to prevent the evils, is almost entirely omitted. No ophthalmologists are quoted or referred to who are on record as to the eyestrain origin of either local ocular or general systematic diseases. Poor old out-of-date Halfort (1845) is wholly forgotten. The same diseases are listed as produced by a few diverse callings, regardless of the fact that they also exist everywhere and in every occupation. It would appear that, to avoid ruination of the eyes by ocular disease, all occupations must be given up. All industrial folk, for instance—it would take pages to enumerate the callings—are cursed with nervous, nutritional, and digestional diseases; but the same fatality persists in the majority of others who are not in such occupations. Eyestrain is never alluded to. The real and amazing rôle of presbyopia in every calling or noncalling is forgotten, although in all those working in lead, zinc, quicksilver, gas, and scores of other industries, the limit of industrial capacity is placed at about that terrible eyestrain year, 45. This unexpected and uncomprehended result suggests nothing to the writers. The height of inconsideration is reached in the official tracing of myopia to a multitude of causes, but never to the true cause, uncorrected hyperopia, astigmatism, and anisometropia.

With dogmatic ruthlessness myopia is called a disease—a disease not at all preventable by glasses correcting the error of refraction—an untruth fraught with tragedy to millions. But swift, safe, or accurate sport or bodily activity, except swimming, is impossible to a high myope. He never dares to run, and all motions must be slow, indefinite, and cautious. He has a stealthy, catlike step. In long tables the greater incidence of eyestrain diseases, according to calling (as in my groups), falls precisely on those doing the greatest amount of near work with the eyes. Amid all these writings there ever jumps up the hideous jack-in-the-box of weird diseases that afflict millions, but which fit into no accepted theory—"neuritis," "rheumatism," migraines, headaches, nervous disorders of a hundred kinds—the miseries of half the world and the mysteries of the whole.

Take a single example of many: The German State insurance department has established sanitaria for the treatment of insured working people who fall ill. The expenses trebled in three or four years, in 1907 amounting to $3,796,575. The workmen, it is naively said, "are eager for this medical treatment, rest, food, shelter, clothing, sanitary surroundings, and care"—such a wholly unnatural finding! A deeper insight into actualities is given in this little table of the working days lost by patients at one of these asylums:

	Men.	Women.
Infections	60	373
Poisonings	1,259	....
Malnutrition	2,773	7,861
Skin, muscles, joints	5,177	953
Nervous disorders	44,965	25,075

Thus, nervous diseases alone caused nearly four times the number of lost working days as resulted from all other diseases combined. The wonderful word "neurasthenia," for a more mysterious and uncaused disease, increased from 18 per cent in 1897 to 40 per cent in 1904. "No difference as to clinical appearances exists between the neurasthenic workmen and the neurasthenic patient of any other social class" is a line of text that suggests, unconsciously, a volume of exegesis. The conclusion is that anemia and neurasthenia are due to "the monotony of work." The physicians of these sanitaria unanimously emphasize the enormous increase of the phychoses, nervous disorders, insanity, and especially of neurasthenia. A word or two is allotted to the part played by the eye, of course, and that eye labor "irritates the optic nerve," illumines abysmal deeps.

Another study takes up the question of fatigue, in which the conclusion is reached that fatigue itself is the great end and danger of occupation. "The neurasthenics of labor," "the self-generated poisons of disease," "the disturbances of metabolism," are offered as the pathogenic factors. A thousand articles written by reputable and earnest physicians are not even referred to, because they give evidence that the etiology of these enormously increasing neurasthenias and other nervous disorders is clear and prevention possible. The therapeutics offered lead to one and only one measure—limitation of the hours of labor. Fatigue, as an explanation of occupational diseases, obscures instead of explains. The difficulty of understanding the causes and of eradicating the evils of such diseases is increased. Fatigue, indeed, per se, differs absolutely from disease. Even if so, how pay these workmen the same as for the present number of work hours? The employers of all nations, civilized or not, must of course give the same added wages; because, of course, the nation that gave the higher wages, without such utterly impossible agreement with all others, would speedily bleed itself to death. One would not be heard who persisted in his protests that the use of the eyes at near range is the now well-known dominant and predominant cause of all these named and misnamed nervous diseases so portentously ingravescent in all modern society. What is also more profoundly active in producing fatigue of the workman than ignored lateral spinal curvature, present in 83 per cent, from adolescence to old age? "Neurasthenia," "migraine," and a score of other diseases are neither uncaused, incurable, nor unpreventable. They are caused by ametropia, curable up to about 40 or 45, and always preventable by scientific spectacle lenses.

As to accidental traumatisms, similar misconceptions are met everywhere. Not even the corneal injuries of stonemasons, emery-wheel grinders, miners, and machine-shop workmen by "foreign bodies" are, it seems, preventable. Even simple plano lenses would stop the wounds and the losses of transparency, and if the ametropic corrections were incorporated many eyestrain diseases would also be obviated. Nowadays the worker with "a foreign body in his eye" is backed against the wall and with knife or pin the speck is picked or dug out by some fellow workman, often with lasting injury greater than if the foreign body were left in situ. Obviable, most all of this, if the workman was instructed in the deft use of a simple wisp of absorbent cotton.

Another fact which is beginning to appear in some of these reports and tabulations is the liability of one eye—usually the left, of course—to be hurt or to go out of use. A few Americans only have asked or understood why. The existence of righteyedness or lefteyedness and their relations to righthandedness and lefthandedness will not, alas, be soon recognized!

All the great treatises on industrial diseases do not even allude to the occupations of the majority of the inhabitants—those of infants learning how to see; of kindergarten children working at near range with fine geometric patterns; of common-school pupils; of seminary, college, and university students; of writers and devotees of learning; of farmers, "hands," and peasants; of housewives; of sailors and soldiers; of the leisure classes; of millions in asylums, hospitals, sanataria, institutions, and prisons; of the senile who do not work; of the unemployed; of craftsmen, such as carpenters, masons, and builders in northern climes during winter; of men not laboring during rain, and many such. Nonoccupation may bring on the same diseases, or even worse diseases, than occupation, especially if near-range vision is forced.

A concrete illustration serves well, i. e., the etiology of myopia. In a country school near Munich, the highest class showed that 2.6 per cent were myopic, of the city school the percentage was 9.8, while of those ready to enter the university 55.9 per cent were nearsighted. So far back as 1866 the number of myopes in the University of Breslau was 60 per cent, in 1890 it was 59 per cent, and in 1902 it was 60 per cent. If myopia is a nonpreventable, causeless, incurable disease, as great and good scientists repeat, then there must be some reason for the statistical differences in our country, since with us the number of myopes is not so great, and we hold a very different opinion concerning the fatality of the disease. The official examination by Dr. Dresbach of 2,484 entering freshmen of Cornell University, demonstrated that 87 per cent were hyperopic, while the percentage of myopes was only about 8. And these results, too, were obtained without the use of a cycloplegic. The work of Risley, which fully and clearly showed the etiology and the preventability of myopia, has long been before all writers and students—before all who wished to see it and know it. Although writing in 1895, the great English oculist, Simeon Snell, accepts Risley's philosophy of the origin of myopia. No; myopia does not exist by the will of God or the fiat of fate; it is not, properly speaking, a disease at all, or, if so described, its origin is known and its preventableness certain. It is caused simply and solely by uncorrected, by overcorrected, or by miscorrected hyperopic astigmatism. There need not be a single myope in the civilized world, and there will not be one when the world becomes genuinely civilized.

The effect of pathogenic illumination in factories, workrooms, schools, and other places is a puzzling one to many investigators. They do not know what to do with the question, and the effects of bad lighting, if any do exist, are noted with peculiar vagueness, and the recommendations made are still more vague. But, in the recent Massachusetts report of the State board of health, it is said:

> It is a well-established fact that either the overuse of the eyes or the use of eyes under bad conditions may give rise to eye fatigue or to eyestrain, and many

> eye specialists believe that at least 80 to 90 per cent of headaches are dependent upon eyestrain. * * * It is impossible to ignore the probability that many individuals working by gaslight, or even by electric light, in dirty, unpainted, overheated rooms, with impure air and excessive moisture, for 10 hours a day, or merely for the last two hours during the day, use up a great deal of nervous energy and suffer from eye fatigue or eyestrain and its consequences.

Forced and "cabin'd, cribb'd, confin'd," as the official admission is, it is nevertheless the frankest and best so far obtained. Of one factory this report says:

> In many rooms the windows are too far apart and the light is barely sufficient, even in good, clear weather. The older weavers complain of failing eyesight, due to working with poor light.

It is indeed promising that this much of attention to the illumination of factories is at last given in this American report. But the sober second thought brings the caution that the illumination in the home room of the examiners was, at best, decidedly poor, as they themselves say of so many factories. Omitted entirely are the great governing principles, that the correction of ametropia is the most important of all prerequisites to avoid eyestrain; that poor illumination quadruples all eyestrain; that no tests of measurements whatever of physiologic and of pathogenic illumination are proposed or dreamed of (as if photometers had never been invented); that the agencies in creating and doubling poor illumination (never good in any factory in the world) of clouds, dirty windows,[3] rain, fog, darkness before sunrise and after sunset, wretched artificial lights, and more than all, the smoke nuisance. These, and many other similar conditions, should have been emphasized. The committee seemed to think that the chief hurt of poor illumination is to the esthetic sense of the factory workers. Fashionable pathology often has the appearance of a palimpsest, its late and erroneous neologisms written over elder, unrecognized, and half-indecipherable vital verities.

It is, in truth, most strange that the science of illumination, as related to ocular physiology and pathology, has scarcely been thought of. We are in a state of utter barbarism concerning it. With all the writing upon occupational diseases plainly due to understimulation, overstimulation, and morbific stimulation of the eyes by light, the essential and basic principles and sciences of photology and photometry have not even been asked for. The tragedies of the albinos, of the nystagmics, of the glass blowers, and other cataractous patients, of welders and workers with electricity, of millions of school children in dark school rooms, of the snow-blinded—these show that a new world of truth as to the proper light stimulus for the eyes remains to be discovered and systematized for humanity's benefit. The use, the nonuse, and the misuse, the world over, of burnooses, hoods, turbans, head wrappings, shades, parasols, fans, hats, and caps, are crude attempts to shade the eyes from hurtful illumination. The whole problem of the tropical diseases of the Caucasian, and of Occidental control of tropical civilizations and barbarisms, is not one of heat, but of illumination, coupled, of course, with eyestrain and the secondary reactions of the organisms against light in the pigmentations of the skin, irises, and retinas. The resensitization of the visual purple of the eyes after exhaustion has been such a million-year-long necessity and difficulty that, to insure it, over a dozen distinct physiological ocular mechanisms have been evolved, and are active every instant of our waking life.

DISCUSSION.

Henry Copley Greene, Massachusetts Commission for the Blind, stated that the commission is working not only to supply work for blind persons, but also to preserve eyesight. It is therefore starting a special class for school children with defective vision and investigating the condition of children with vision of half normal or less, with glasses. Hypermetropic children were found to be more frequent than myopic. What children should presumably be removed from the ordinary schools? Children requiring minus six or minus nine glasses seem obvious cases for a special class. But what of children with lesser defects? What standard can be suggested?

Dr. Charles W. Crankshaw: I desire to offer my appreciation of Dr. Gould's admirable paper, and, as physician in charge of the infirmary of the Prudential Insurance Co. of America, where about 3,500 persons are employed, and of this number about 3,000 as clerks, I have the opportunity of seeing many cases from time to time where the eyes have been at fault in causing many symptoms, from those of a slight nature to those of serious disturbance, the employee being for a time entirely unfitted for duty. Recently a case was brought to the infirmary in a rolling chair, the patient having had a severe attack of vertigo. This patient was a very intelligent young man, and, in addition to his office work, was doing translations at his home in the evenings. The first impression of this case was that of a neurasthenic, but after going over the various phases of the case I decided that the eyes were causing his trouble. He was referred to a conscientious oculist, and I use the term "conscientious," having in mind the fact that results will be far-reaching with such an oculist, just as good results may be expected in surgical cases where the surgeon has the "aseptic conscience." He was advised to remain away from the office for at least one week, and the oculist found a myopic condition of one eye especially, with astigmatism. After receiving his glasses he returned to his desk, the symptoms disappeared, and he was profuse in his thanks that the cause of his trouble had been found and relieved.

Dr. **Julius Grinker**, Chicago: Dr. Gould's excellent paper takes cognizance of only one kind of cause, namely, eyestrain. Personally I know, for instance, that typesetters have not much need for glasses, but are neurotic, because, in this country, at least, typesetters are alcoholic. So what proof have we that alcohol is not the real cause of the neuroses? The danger is that we are apt to generalize too much. Dr. Gould is so steeped in eye specialism that nothing but eyes are visible to him, and they are all defective and in need of spectacles. We must take in all the causes, and not merely a single one.

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[1] This upward looking seems to me trivial as an explanation of nystagmus and of other diseases. Citation of Michael Angelo's poem upon his own case does not carry conviction. Such sufferers exist in thousands who do not work upon objects above their heads.

[2] Examples are: Farmers, typewriters, real-estate dealers, nut and bolt makers, rural mail deliverers or carriers, servants, wagon makers, watchmen, peddlers, teachers, Senators, politicians, and business men.

[3] In one factory the window panes were painted to keep the work folk from looking out.

A NEW THERAPEUTIC AGENT IN OPHTHALMOLOGY.

Dr. C. G. **Precerutti**, head physician of the ophthalmological section of the Cottolengo Hospital, and head consulting physician at the Ophthalmic Hospital of St. Joachim, of Turin.

In the course of his researches into the physiological action of the different electrical emanations (radiation), the author, having ascertained that they produce a sensible modification of our organism, causing an increase of the circulation and a dilatation of the lymphatic vessels, and thinking that in the living organism these modifications take place as a result of the action of the galvanic current, wished to determine if radium would give the same results when applied to the eye, in the treatment of which electrotherapeutics holds such an important place.

As a matter of fact, radium, being composed of alpha α (anodic) and beta β (cathodic) rays, lends itself wonderfully to this purpose. Thanks to his own experiments, and to those of other scientific men, the author has been able to prove that radium ionises the air.

When we shut up a quantity of radium in a glass, we observe an ionisation of the air between the eye and the glass. These ions, thrown out at a speed only slightly less than that of light rays, easily penetrate into the human body, and, in the case of the eye, there is even less resistance, for, whereas the skin (epidermis) generally offers a considerably higher degree of resistance to the passage of the current than any other animal tissue, in the eye the resistance is reduced to a minimum, on account of the opening of the eyelids.

With regard to the penetrative power, we have the decisive experiments of Rutherford which demonstrate that radium rays, taken altogether, are thrown out to a distance of 80 millimeters in the air, and that they are transmitted still more easily to a distance of several centimeters. The fact that the rays always travel some centimeters in the air should answer those who urge, as an objection, the weak penetrative power of α radium rays.

One of the peculiar properties of radium is that it penetrates through the substance of the vessel in which it is inclosed, and glass is the substance which offers least resistance to its passage. As a matter of fact, in the treatment of morbid growths, where radium is used as a curative agent, it is inclosed in a glass vessel of appropriate form, which is then applied to the diseased part, either directly, or at a short distance, whence the curative rays emanate.

One important fact, which is particularly worthy of our attention with respect to the invention under discussion, is that the author has been able to prove that, in spite of the radioactivity of the lens—and we need not mention the experiments that have proved that, in these proportions, all irritating effects are impossible—the cornea and the crystalline lens of living animals, after a long exposure to a strong emanation of radium, do not suffer the slightest alteration, and the pupillary reaction also remains intact.

Flemming also communicated to the Ophthalmological Society of Berlin a few months ago that, having exposed the cornea of rabbits for 20 hours to the action of radioactive rays, he has been able to prove that they underwent no change (which is certainly owing to the nonvascular structure of the cornea).

The author bids us note that the emanation thrown out from radium is never modified, even by the action of the most powerful agents. Neither acids, nor the platinoids blown by electricity to the highest possible temperature, nor chromate of lead blown red-hot, have been able to modify it; neither is it modified by being incorporated with glass, although, in this case, the material is subjected to very high temperatures.

A proof of this is the photographic plate, which receives an impression even at a certain distance, and the electroscope of Prof. Curie, with which the ionisation of the air can easily be demonstrated, determining the radioactivity of the lens.

Here the author makes another observation, namely: On first reading the description of the curative effects of radium, one might be led to believe that it has a modifying and even a destructive action on the tissues. I declare at once that the action is directly in proportion to the radioactivity of the salt or radioactive substance used, as is the case with all substances whose effects vary according to the more or less concentrated dose in which they are employed.

But, in order to explain the true action of the radioactive glass on the eye, we shall endeavor to define it.

By means of the measured radiation emanated by the radioactive glass, the fluids of the eye are rendered electrolythic and we thus produce, on the globe of the eye and on its appendages and inner membranes, a slow and gradual cathaphoretic and ionising action.

It is quite natural that the lens should have a cathaphoretic action, when we consider the various kinds of collyrium that are used for all morbid conditions of the eye, such as mydriatic, myotic, analgesic; disinfectants acting on the exchange, and so forth.

Finally, in answer to the objection that the small quantity of radium contained in the lens is insufficient to serve the purpose proposed by the author, the experiments described at the end of this paper prove that it has been found sufficient for the use to which it is destined. Moreover, I would remark that, independently of the numerous personal trials which I have given it, I could bring another proof of the soundness of my assertion and that is hydrology, through which it has been possible for us to know that the curative properties of certain waters is due to infinitesimal quantities of radium which they contain; for example, the waters of Carlsbad.

If we are to trust the analyses of theories of ions, we know that electrolythic solutions show their activity particularly when the electromotive power is very feeble.

It is natural that one of the first therapeutic results of radioactive lenses should be analgesic (of this I shall speak in another paper), and, considering the knowledge we have had of the analgesic properties of radium ever since its first discovery, the fact might have been taken for granted, and any mention of it is almost superfluous.

The rays emanated by radium are of three kinds, α, β, γ, and these last may be compared to X rays. It would seem, then, that the presence of these rays should cause capillary hyperœmia of the choroid membrane by causing disturbances of the nutrition, but we have learnt from Herman that if the action is moderate we get a stimulation of the exchange of the epidermis (ciliary border), which has been taken advantage of in certain cases of ciliary blephatitis and of neuralgia.

Morris Sachs, who was really the precursor of experimenters in seeking to determine the action of radium on the eye, was the first to prove that the action of radioactive rays affect not only the front of the retina but also the back, a phenomenon by Konigstein which was attributed to the fluorescence of the membranes of the eye caused by the induced radioactivity.

To sum up, Dr. Precerutti's radio-active lens, besides answering all optical purposes, being a corrective lens similar to those already on the market, is at the same time a curative lens containing in the glass a radium salt, chosen and measured so that only its therapeutic emanations can be utilized, and these in small quantities and for considerable periods. This is the only way in which practical and constant effects can be obtained by the use of radium.

This lens is absolutely safe, and persons who have used it have never had to complain of any derangement. On the contrary, our experience has given positive results that have but confirmed all our expectations.

The lens I have used in my practice, and in which I had incorporated a radioactive salt, had nothing particular about it, as far as its shape and corrective power were concerned. It was, indeed, worked like the usual lens for the correction of defects of vision. I have used it mounted as spectacles and pince-nez, and I have never had occasion to note that it produced the slightest irritation, although the patient wore it continuously.

AN UNSUSPECTED CAUSE OF CAISSON DISEASE.

T. Kennard Thomson, honorary vice president of the American Society of Mechanical Engineers.

In order not to repeat what others have said, I will simply try to emphasize one point, and that is that foul atmosphere, even at very low pressure, is often more dangerous to men than much higher pressure where the air is not so contaminated.

We are considering the effect on the human body of forcing enough air into a working chamber of a horizontal tunnel or vertical shaft to prevent the water entering that chamber while the men are excavating or doing other work.

The air must, of course, be compressed sufficiently to hold back a head of water equal to the depth above the cutting edge of the caisson. So if the cutting edge is 100 feet below the surface of the water, and we assume the water to weigh 62½ pounds per cubic foot, then the weight of a column of water 1 inch square and 100 feet high will be 43.4 pounds; so the air pressure required to balance a 100-foot head of water is 43.4 pounds per square inch, in addition to ordinary atmospheric pressure, and will vary exactly as the depth for greater or less penetration.

Two actual cases will be cited to prove the above statement about foul air:

The first case was on the Ohio River, where a caisson had been sunk to rock and the working chamber filled with concrete, and the steel shafting above the deck was being removed. In this particular case there were several working shafts, 3 feet in diameter, to permit the men and material to enter and leave the caisson. About 8-foot lengths of these shafts were bolted to the roof or deck of the caisson and buried in the concrete, though sometimes only 2-foot lengths were thus buried. Timber forms prevented the concrete coming into contact with the shafts above this level, as it was much cheaper to remove the steel shafts before filling the space with concrete.

Now, when pumping compressed air into a vertical caisson or horizontal tunnel there is a very considerable loss of air into the soil, and this loss requires continual pumping of fresh air into the working chamber, thus keeping the atmosphere fairly good. But as soon as the concrete in the working chamber is brought above the cutting edge the amount of lost air is reduced very considerably, and by the time the air chamber and bottom section of the shaft is filled there is comparatively little escape of air, and very little pumping is required. The air pressure should, of course, be reduced as each foot of concrete is placed in the working chamber and shaft; otherwise the air would tend to blow the water out of the concrete.

Now, in the case cited, a skilled mechanic thoroughly accustomed to working in compressed air was in the shaft after the bottom section had been filled with concrete and the air pressure reduced accordingly, and took, for some reason or other, a little longer than usual to remove the bolts and just had time to signal for help before being overcome, and was taken out dead, although he was apparently in perfect condition when he entered the shaft and working under conditions to which he was well accustomed.

The second case was in the caissons for the Lenox Avenue Bridge in the Harlem River, New York City, in 1901–2, where considerable trouble was caused by men complaining of the "bends" (caisson disease) when passing through the foul mud in the bottom of the river, although the air pressure was not high enough to be noticed under ordinary conditions, and in each caisson, after the cutting edge had penetrated into the clean clay at much greater depth, the trouble ceased.

It might be stated that "sand hogs," as caisson workmen are called, do not pay much attention to air pressures below 15 to 20 pounds in addition to atmospheric pressure, but from 20 to 30 pounds the change is noticed very quickly, while 48 to 50 pounds is the very highest that men can stand under present working conditions, and even then the time of the working shifts is only three-quarters of an hour twice a day.

The writer had the "bends" twice in less than 25 pounds pressure, after the cutting edge had been sealed, and has worked in 42 pounds without any ill effects, showing that the foul atmosphere, his temporary condition, or some other cause did the damage in the lower pressure.

It might be stated that the Harlem River is a short stretch of water about 6½ miles long, connecting the North or Hudson River with the East River and passing through the city of New York, and thus forming the island of Manhattan. Many sewers drain into the Harlem, Hudson, and East Rivers, and it is claimed that the tides (4 to 5 feet) carry all the sewage out of the Harlem River into the Hudson or East Rivers; but as proof that this is not so, in addition to the above-cited case, it might be stated that any excavation made from the surface in the Harlem River discloses a black putrid mud of very offensive smell; and, further, the gas from this mud is continually escaping to the surface—all of which shows the criminal folly of depositing sewage in the Harlem River. Nor should it be allowed to enter any of the rivers or bays of New York, but should be treated or carried out to the ocean in a large trunk sewer: otherwise a great epidemic will sooner or later occur.

DIE GEFAHREN DER CAISSONARBEIT.

Dr. Philipp Silberstern, k. k. Polizei-Ober-Bezirksarzt (Wien).

Das Interesse, welches den Gefahren der Druckluftarbeit zugewendet wird, ist in fortwährender Steigerung begriffen. Es äussert sich in Wort und Tat. Die Autoren haben die persönliche Führung auf dem langsamen Wege übernommen, auf welchem das Menschengeschlecht in die Wassertiefe vorzudringen sucht.

Noch kein Caissonarbeiter war in jenem Ueberdrucke beschäftigt (6.1 Atmosphären), welchen Greenwood[1] im November 1905 erreicht hat; noch kein Berufstaucher ist folgenlos aus einer solchen Tiefe (64 m entsprechend dem Ueberdrucke von 6.4 Atmosphären) zurückgekehrt, wie Damant im August 1906.

Vor zwanzig Jahren wurde an der Möglichkeit gezweifelt, dass ergiebige Arbeit in Luft von einem Drucke geleistet werden kann, welcher in der Tiefe von 50 m dem Wasserdrucke das Gleichgewicht hält (5 Atmosphärenüberdruck). Die Experimente Layet's und der französischen Studienkommission 1894 waren nötig, um diese Zweifel zu zerstreuen.

Weiter werden seither die Grenzen gesteckt, bis zu welchen der Mensch, von der Druckluft des Taucheranzuges oder des Caissons

umschlossen, im Wasser bezw. unter dem Wassergrunde in wasserführendem Boden zu arbeiten imstande ist. In dem Werke der englischen Tieftauchkommission, bezw. Haldane's finden wir die Zuversicht, dass auch in Wassertiefen von mehr als 100 m mit den gegenwärtigen Hilfsmitteln vorgedrungen werden kann.

Das Schreckbild der Sauerstoffvergiftung verblasst einigermassen. Noch kein Tieftaucher, geschweige denn Caissonarbeiter hat im Stadium des konstanten Ueberdruckes die Konvulsionen und die Lungenentzündungssymptome acquiriert, welche das Tierexperiment bei hohem Druck und langer Aufenthaltsdauer erwarten lässt.

Auserordentlich häufig sind dagegen die Krankheitsgefahren, welche dem Caissonarbeiter (und Taucher) nach dem Uebertritte aus der Druckluft in die freie Atmosphäre drohen. Die Eigenart dieser Drucklufterkrankungen ist nunmehr allgemein anerkannt und in das Bewusstsein weiter Kreise gedrungen, ein Fortschritt gegen die Zeit, in welcher diese Erkrankungen von einflussreicher Seite als Aeusserungen des Alkoholismus gedeutet wurden und meinen prophylaktischen Bestrebungen das misdeutete Wort entggenarbeitete: "Es gibt keine Caissonkrankheit."

An allen Orten, an welchen Bauarbeiten unter grösserem Ueberdrucke stattfinden, werden plötzlich einsetzende, stürmisch verlaufende, oft flüchtige Ausschleusungskrankheiten beobachtet. Da sie nicht immer innerhalb der ersten Stunde nach Verlassen der Arbeit, sondern manchmal erst nach vielstündiger Latenzzeit auftreten, mithin oft genug sich auf der Strasse ereignen, allarmieren sie die grosse Oeffentlichkeit. Infolge des Vorkommens von Invaliditäts- und Todesfällen, welche durch geeignete, beim Baubeginn zu treffende Vorkehrungen verhütbar sind, belasten sie die Unternehmungen und die Behörden mit der grössten Verantwortlichkeit.

Unbestritten ist P. Bert's Lehre, dass in der komprimierten Luft des Caissons die Körpersäfte umso reichlicher die Gase des umgebenden Mediums, vorwiegend Stickstoff aufnehmen, je höher der Druck ist. Nach fehlerhaftem Druckabfall kommt es zur Entladung von Luftbläschen in den Gewebsflüssigkeiten und im Blute. Den anschaulichsten Nachweis haben 1903 Hill und Macleod beschrieben, welche am unverletzten Tiere das Entstehen von Luftbläschen nach dem Druckabfall verfolgen konnten, als sie unter Verwendüng einer mit Schau gläsern ausgestattëten Druckluftkammer den Kreislauf in den Blutgefässen der Froschschwimmhaut beobachteten.

Die Lehre P. Bert's wurde durch eine unscheinbare, zahlreiche Widersprüche zwischen Theorie und Erfahrung überbrückende Feststellung Vernon's 1907 ergänzt: "Von Fetten und Lipoiden wird nahezu sechsmal so viel Stickstoff absorbiert als vom Blute." Durch Vernon's Feststellung ist die vorzugweise Gefährdung bestimmter

Organe zu erklären, wie sie experimentell als lokale Gasentwicklung in den Gewebsspalten des Fettgewebes, in der Substanz der schwächer durchbluteten und schwerer zu entgasenden Rückenmarksabschnitte ihren Ausdruck findet.

Die übliche, von mir herrührende Bezeichnung Aërämie umfasst nicht sämtliche Krankheitzustände. Sie muss, wie insbesondere der Befund von Luftbläschen in der Gelenksflüssigkeit zeigt (Haldane, Quincke), durch die Bezeichnung Aërolymphe ergänzt werden. Durch ihre Häufigkeit belasten die Glieder- und Gelenksschmerzen trotz kurzer, zumeist eine Woche nicht überschreitender Dauer die Krankenkasse-Statistik in hohem Grade. Weit wichtiger sind die Ménièreschen Erscheinungen und die Rückenmarkslähmungen (Ischämie, Erweichungsherde), welche bleibende oder vorübergehende Invalidität bedingen. Luftembolien im Gebiete des kleinen Kreislaufes kommen in erster Linie als Ursache der foudroyanten Todesfällen in Betracht.

Vernon's Feststellung hat es ermöglicht, das Gefahrsmoment der Aufenthaltsdauer in komprimierter Luft einheitlich zu werten. Schon beim Bau der Mississippi-Brücke zu St. Louis 1870 hat Eads festgestellt, dass gelegentliche Besucher der Druckluftträume gesund blieben. Als mit dem Sinken der Caisson und mit dem Steigen des angewandten Ueberdruckes die Entschleusungskrankheiten immer zahlreicher und gefährlicher wurden, gelang es Eads durch Reduktion der Schichtdauer auf eine Stunde, die schweren Krankheiten zu verhüten. Von den Technikern wurde in verschiedenem Masse der Notwendigkeit Rechnung getragen, die Schichtdauer mit steigendem Ueberdrucke zu verkürzen.

Nun hat Zuntz 1897 die zahlenmässige Erfassung der Vorgänge bei der Gasaufnahme gelehrt. Rasch erfolgt die Stickstoffsättigung des die Lungenkapillaren durchströmenden Blutes. Ein rasches, wenngleich allmählig sich verzögerndes Tempo wurde für die Sättigung der Gewebsflüssigkeiten angenommen, so dass es gleich gefährlich schien, ob jemand eine oder mehrere Stunden im Caisson sich aufhalte.

Zuntz hat die Rechnung ohne Fette und Lipoide gemacht. So manche Autoren, welche gleich mir in Druckluft Beobachtungen anstellten, haben das erhebende, aber durch nichts gerechtfertigte Gefühl genossen, eine grosse Gefahr überstanden zu haben. Die Stickstoffspeicherung der Gewebe, insbesondere der fetthaltigen, ist ein langsamer Vorgang. Sie erfordert nach Boycott-Damant-Haldane etwa 5, nach Bornstein etwa 9 Stunden. Sicher ist nicht in 20 Minuten, wie von Schrötter berechnet, sondern erst in einem Vielfachen dieser Zeit die Gefahrsgrenze erreicht.

Die Verkürzung der Schichtdauer, wie sie im holländischen Gesetze angeordnet ist, geht nicht zu weit, wie Zuntz auf dem letzten hygienischen Kongress andeutete. Sie geht nicht weit genug und wird mit Recht vom New Yorker Gesetz in ähnlichem Ausmasse präzisiert, wie es Brennecke im Handbuch der Baukunde 1887 getan.

Arbeiten, bei welchen eine Atmosphäre Überdruck nicht erreicht wird, bedingen nicht die Gefahren der Aërämie und Aërolymphe und bedürfen keiner Schichtverkürzung. Sie können nur Trommelfell- und Mittelohraffektionen, relativ harmlose Erkrankungen verursachen, wenn der Arbeiter in der Vorkammer einem allzuraschen Druckanstiege ausgesetzt ist und wenn bei minder wegsamer Ohrtrompete sich der Druckausgleich zu beiden Seiten des Trommelfells verzögert.

Von entscheidender Wichtigkeit für die typischen Gefahren der Druckluftarbeit ist die Schnelligkeit und Art des Druckabfalles. Beim Caissonbetrieb erscheint es notwendig, für die Dekompression um eine Atmosphäre Überdruck durchschnittlich die Zeit von 15–20 Minuten zu widmen.

Die schlechten, durch kurze Ausschleusungszeit bedingten Resultate wurden vielfach auf die Ungleichmässigkeit der Druckverminderung bezogen. Beim Oeffnen des Ausschleusungshahnes strömt der Ueberdruck zunächst sehr rasch, dann immer langsamer und langsamer ab, weil die Druckdifferenz zwischen Schleusenluft und Druckluft während der Ausschleusung immer geringer wird. Zur Abstellung dieses scheinbaren Uebelstandes gaben Michel 1879 u. A. sinnreich konstruierte Ausschleusungshähne an, verlangten mit besonderem Nachdrucke Heller-Mager-von Schrötter gleiche Dekompressionszeiten für jedes Zehntel einer Atmosphäre und bestimmte das niederländische, sowie das französische Regulativ längere Ausschleusungszeiten für die ersten, wie für die späteren Stadien der Ausschleusung.

Im Gegensatz zu diesen Bestrebungen brachte das Jahr 1907 eine wichtige, den scheinbaren Uebelstand systemisierende Errungenschaft: Haldane's staffelförmige Dekompression, welche auf Vernon's Feststellungen Bezug hat und auf folgenden Erwägungen basiert: Selbst während der langsamsten Ausschleusung entledigt sich der Organismus nicht völlig seines überschüssigen Stickstoffes. Insbesondere dauert es eine Reihe von Stunden, ehe die in den fetthaltigen Geweben aufgespeicherte Gasmenge vom Blute aufgenommen wird, um in die Kapillaren der Lunge, des Darmes, der Haut befördert zu werden und in die Aussenluft zu diffundieren. Blut und Gewebsflüssigkeit sind fähig, ein bestimmtes Gasvolumen in übersättigter Lösung festzuhalten. Luftbläschenbildung und Krankheitsgefahr droht erst dann, wenn der Stickstoffdruck in den Körpersäften mehr als zweimal jenen der atmosphärischen Luft überschreitet. Jede Druckhöhe kann ohne Gefährdung der Druckluftarbeiter brüsk bis auf die Hälfte des Totaldruckes reduziert werden. Beim Sinken des Totaldruckes von 6 auf 3 Atmosphären wird dasselbe Gasvolumen überschüssig, wie beim Sinken des Totaldruckes von 2 auf 1 Atmosphäre, i. e., beim Ablassen des Ueberdruckes von 1 Atmosphäre. Der plötzliche, ruckweise Druckabfall ist sicherer wie der gleichförmige. Die staffelförmige Dekompression mit entsprechend langen, je nach der Aufenthaltsdauer in komprimierter Luft bemessenen, tabellarisch zusammengestellten Pausen und besonders langsamem Ausgleich der letzten halben Atmosphäre des Überdrucks hat sich an den Tauchern der englischen und der italienischen Kriegsmarine bewährt.

Haldane's Methode der "stage decompression" bedarf für die Caisson arbeit einer entsprechenden Modifikation, welche ihre Vorteile verwertet, ihre Nachteile ausschaltet. Ein Nachteil ist der einleitende allzu grosse und allzu starke Drucksturz mit seinen Abkühlungs- und Durchnässungseffekten.

Für den Caissonbetrieb ist nach meinem Vorschlage die erste Hälfte des Druckabfalles derart zu beschleunigen, dass etwa ¾ Minuten auf je 0.1 Atmosphären, die zweite Hälfte derart zu verlangsamen, dass etwa 3 Minuten auf je 0.1 Atmosphären entfallen.

Nicht im Caissonbetreibe, wohl aber bei pneumatischer Vortreibung von Tunnels können Unterbrechungen des Druckabfalles mit besonderem Vorteile verwendet werden. Das Verweilen des Arbeiters in einer intermediären Tunnelstrecke, "Purgatorium" Haldane's, welche als Aufenthaltsraum ausgestattet ist, sich mit Sauerstoffapparaten versehen lässt und einen geringeren Ueberdruck als den einer Atmosphäre aufweist, ermöglicht es, den Aufenthalt in der nachfolgenden, räumlich beengten Luftschleuse abzukürzen. Ein längerer Weg, welcher unter gleichem Ueberdruck von einer Luftschleuse zur nächsten zurückzulegen ist, sichert die nötigen Ausschleusungspausen und veranlasst leichte körperliche Betätigung, mithin eine Beschleunigung des Blutumlaufes und der Entgasung.

Auch im Punkte "Auswahl der Arbeiter" vollzieht sich die Rückkehr zur Weisheit der Alten. Niemand bezweifelt, dass Herz- und Lungenkranke von der Caissonarbeit ferngehalten werden müssen und dass verschiedenartige pathologische Zustände die Entgasung beeinträchtigen können. Aber selbst unter gesunden und jüngeren Arbeitern sind nicht alle in gleichem Grade für die Druckluftarbeit tauglich. Die von früheren Beobachtern angenommene, von Heller-Mager-von Schrötter negierte Disposition für die Caissonkrankheit besteht zu Recht.

Physische Eignung für die Druckluftarbeit dürfen wir dem berühmten Taucher Erostarbe zuerkennen, welcher, um Silber aus einem gesunkenen Schiff zu heben, durch Wochen aus Wassertiefen von mehr als 50 m 2–3-mal täglich mit gefahrdrohender Schnelligheit aufstieg. Auf besondere Empfänglichkeit für die Caissonkrankheit müssen wir dagegen die permanente Rückenmarkslähmung jenes Druckluftarbeiters zurückführen, von welchem Keays 1910 berichtet, dass er nach der Schleusungsprobe (einstündiger Aufenthalt unter dem Ueberdrucke von 2.2 Atmosphären) und nach ¼-stündiger Dekompressionszeit erkrankte. Dass grösserer Fettgehalt des Körpers oder der Nahrung zur Erkrankung disponiert, ist durch Vernon's Feststellung begreiflich und durch den Caissontod veranschaulicht, welchen die fetten Meerschweinchen Boycott-Damant's im Gegensatze zu den magern fanden. Mit grösserem Verständnis erinnern wir uns daran, dass A. Smith die Körperfülle von Caissonarbeitern perhorreszierte und dass beispielsweise bei den pneumatischen Fundierungen zu Toulon in den 70er Jahren, fettleibige Arbeitswerber nicht aufgenommen wurden.

In der minderen Gefährdung des geschulten Caissonarbeiters im Vergleiche zu jener des Neulings prägt sich meines Erachtens nur die individuell verschiedene Eignung aus. Die natürliche Auslese ist es, welche unter enormem Arbeiterwechsel das Ausscheiden der untauglichen und das Zurückbleiben der tauglichen Leute bewirkt. Wenige Schleusungsproben, wie sie von Keays angewendet wurden, genügen, um besonders disponierte Personen zu erkennen und Leute, welche schon bei geringem Ueberdruck oder bei geringer Aufenthaltsdauer in Druckluft erkranken, vor Arbeit bei höherem Ueberdruck und vor schwerer Schädigung zu bewahren.

Eine Steigerung der Gefahren für den Caissonarbeiter durch reichlichen, beispielsweise 2 Prozent betragenden Kohlensäuregehalt der Druckluft ist nach den Untersuchungen Greenwood und Hill's nicht anzuerkennen. Ja, vom Kohlensäurereichtum der Schleusenluft versprechen sich die genannten Forscher sogar günstigste Erfolge, eine Steigerung der Lungenventilation und eine raschere Stickstoffausscheidung während der Dekompression. So bemerkenswert diese Untersuchungen sind, so wenig dürfen sie die Hygiene der Caissonarbeit beeinträchtigen. Welche Bedeutung mangelhafte Luftzufuhr und Kohlensäureintoxikation im Stadium des Ueberdruckes für die Arbeiter gewinnen kann, hat Haldane selbst gezeigt. Im Berichte der englischen Tieftauchkommission, dem bedeutendsten einschlägigen Werke seit P. Berts Tagen, weist er nach, dass die Kohlensäurespannung im Helme es ist [und nicht der Luftdruck], welche die Kraftlosigkeit und Benommenheit von Tauchern bei hohem Ueberdruck erklärt. Durch Festsetzung der für die jeweilige Tiefe erforderlichen Luftmenge hat Haldane die Leistungsfähigkeit des Tieftauchers gesichert. Auch in der Arbeitskammer des Caissons hat bei einzelnen Fundierungen die Kohlensäurespannung eine an sich bedenkliche Höhe erreicht.

Für gewöhnlich hat die Kohlensäure des Caissons keine Bedeutung als toxische Substanz. So manchesmal aber ist sie als Indikator ungünstiger Temperatur-, Feuchtigkeits-, Luftzuführungsverhältnisse beachtenswert. Thermische, chemische und andere Schädlichkeiten, welche die für die Entgasung wichtige Funktion der Haut, des Darmes, der Lungen beeinträchtigen oder die Herztätigkeit verringern, können zur Caissonkrankheit prädisponieren.

Wie bisher müssen wir grosse Luftschleusen anstreben. Wir müssen auch weiterhin das Zusammenpferchen der Arbeiter hintanhalten und müssen den Temperatursturz der Ausschleusung verhüten, wie es in Amsterdam mittels elektrischer Oefen durchgeführt wurde. Einen Menschenüberfüllten und hiedurch Kohlensäurereichen Raum möchte ich niemals als Inhalatorium anpreisen, stets nur als Ausdruck eines hygienischen Uebelstandes verwerfen.

Seit den Zeiten François' ist mässige Bewegung nach der Ausschleusung üblich. Der Hinweis Bornstein's, dass intensive Arbeit während und nach der Ausschleusung die Stickstoffausscheidung maximal beschleunigen würde, die Bedenken Quincke's, dass jede Bewegung die Gasbläschenbildung in übersättigter Lösung anregen kann, sind Laboratoriumsergebnisse eines und desselben Jahres 1910. Der Praktiker wird sich nicht vom Mittelwege ablenken lassen; er wird nicht der Ueberbürdung das Wort reden, welche die Herzaktion und Entgasung ungünstig beeinflusst und wird nicht auf Seite Lauenstein's zu finden sein, wenn dieser die Mannschaft nach getaner Arbeit ins Bett zu bringen versucht. Die Rückversetzung erkrankter Caissonarbeiter in Druckluft gilt seit den Arbeiten im Gebiete von Douchy 1847 als das Rettungsmittel in der Gefahr. Der Mechanismus der Wirkung wurde 1903 von Hill und Macleod veranschaulicht, welche während der Rekompression das Verschwinden von Luftbläschen im unverletzten Tiere nachweisen konnten, als sie unter Verwendung einer mit Schaugläsern aus, gestetteten Druckkammer die Blutgefässe der Froschschwimmhaut beobachteten.

Eine Gruppe von Autoren (u. a. Houdeville, Lauenstein) hat Zweifel an der Wirksamkeit des Mittels ausgesprochen. Jedes Heilmittel kann in einzelnen Fällen versagen, insbesondere bei verspäteter, nach Ausbildung irreparabler Gewebsschädigungen einsetzender oder unsachgemässer Anwendung. Wohl alle Augenzeugen der Rekompression sind gleich mir Augenzeugen der Rekompressionserfolge. Nach wie vor kann auf die Unterbringung der Arbeiter nächst dem Arbeitsplatze, auf ärztlichen Permanenzdienst und auf die Bereitstellung einer mit Sauerstoffapparaten versehenen Rekompressionskammer bei einem Ueberdrucke, welcher 1.5 Atmosphären erricht, nicht verzichtet werden.

Zuntz hat vorgeschlagen, während der Ausschleusung durch Sauerstoffatmung die Spannungsdifferenz zwischen Stickstoff des Körpers und jenem der Schleusenluft zu vergrössern, um die Stickstoffausscheidung zu beschleunigen. Für die Kranken in der Rekompressionskammer ist dieser Vorschlag wichtig, dessen Wirksamkeit und Anwendbarkeit in der Luftschleuse Bornstein erprobt hat: Die

Atmung eines 90–95 Prozent Sauerstoff enthaltenden Gasgemisches hatte selbst bei ½-stündiger Dauer und bei einem Ueberdruck von zwei Atmosphären noch keine nachteiligen Folgen gezeitigt, ist mithin in der zweiten Phase der Dekompression selbst nach Erreichung höheren Ueberdruckes anwendbar.

Das Mass der Gefahr wird immer noch unterschätzt. Die in der Literatur niedergelegten Zahlenverhältnisse bedürfen einer Interpretation. Der Bericht der englischen Tieftauchkommission entreisst die unvorsichtige Ausschleusung beim Scorff-Brükenbau 1862 der Vergessenheit, bemerkt aber, dass nur zwei Todes- und 14 ernste Erkrankungsfälle vorkamen, trotzdem die Zahl der Schichten 8,042 betrug. Nun bedeuten 8,042 Schichten nichts grosses, sie sind der Jahresleistung eines Arbeiterstandes von nur 10–15 Mann gleichzusetzen, von denen jeder zweimal täglich eine vierstündige Arbeitsschichte absolviert. Ein einziger Pfeiler der Brücke erreichte die Versenkungstiefe von 18 m. Nur wenige Tage hindurch war ein Ueberdruck nötig, welcher schwere Erkrankungen oder Todesfälle ermöglicht. Unter den 14 Fällen figuriert nicht jener des Ingenieurs Gallois, welcher eine Rückenmarkslähmung erlitt, vergebens eine Entschädigungsklage gegen die Unternehmung einbrachte und zwei Jahre nach dem Unfalle starb. Die verantwortlichen Organe der Unternehmung wurden vom Tribunal von Lorient und vom Appellgerichtshof von Rennes freigesprochen. Die Nachwelt kann die Bauführung von Verschulden nicht freisprechen und wird ihre Sympathien dem Andenken des Ingenieurs Gallois bewahren.

Das imposanteste Werk der Tiefbautechnik unserer Zeit, die pneumatische Vortreibung der East River tunnels 1906–1908 unter einem Ueberdrucke von 2.1, gelegentlich selbst 2.8 Atmosphären, hatte, wie Keays berichtet, über 3,600 Drucklufterkrankungen, darunter 20 Todesfälle im Gefolge. Da infolge des grossen Arbeiterwechsels die durchschnittliche Verwendungsdauer jedes Arbeiters nur wenige Wochen betrug, ist für die Morbiditäts-Statistik das Résumé nicht verwertbar, welches die Mortalität mit Rücksicht auf die Zahl der untersuchten 10,000 Arbeiter auf bloss 0.2 Prozent angibt. Wohl aber lässt sich gewerbehygienisch verwerten, dass die Morbidität bezogen auf 557,000 Arbeitsschichten 0.66 Prozent, die Mortalität 0.0035 Prozent betrug. Es waren durchschnittlich nicht mehr als 1,000 Mann täglich beschäftigt: es kamen im Jahre mehr als 2,400 Drucklufterkrankungen und mehr als 12 Drucklufttodesfälle vor. Die englische Tieftauchkommission hat die Druckluftaffektionen der ersten vier Monate mitgeteilt: 4 Todesfälle, 62 schwerere, 515 leichte Erkrankungen, bei rund 60.000 Dekompressionen. Es gerreicht dem ärztlichen und technischen Stabe zur grössten Ehre, die ursprünglichen Massnahmen immer von neuem verbessert und ein weit günstigeres Gesamtresultat erzielt zu haben, als die ersten vier Arbeitsmonate voraussehen liessen.

Wenn nun unter so hervorragender Leitung eine immer noch grosse Gefährdung der Caissonarbeiter resultiert, dann lässt sich ermessen, wie sehr für gewöhnlich Gesundheit und Leben der Druckluftarbeiter bedroht sind. Nur zu gut sind die krassen Misstände anderer Druckluftgründugen bekannt: Schleusen ohne Manometer, Caissonarbeiter ohne Tauglichkeitsbefund, Schleusenmänner ohne Uhr, Caissons ohne Schutz vor exzessiver Temperatur, schwerster Luftverderbnis, unsinnigen Drucküberschreitungen, überflüssigen Druckschwankungen, Bauplätze ohne Anschlag einer Arbeitsordnung oder eines Merkblatts, Aufsichtsorgane ohne Kenntnis der geltenden Vorschriften.

Brennecke spricht sich nicht mehr gegen die behördliche Kontrolle der Druckluftarbeit aus. Er schliesst sich vielmehr den Argumenten an, welche ich als Referent unseres Themas auf dem Berliner hygienischen Kongress vorgebracht habe. An dem Verhältnis der Krankheitsfälle zur durchschnittlichen Arbeiterzahl, einer für Caissonarbeiten nicht üblichen Berechnungsart, konnte ich die beispiellose Morbidität, Invalidität und Mortalität, die erschreckenden Gefahren der Caissonarbeit nachweisen.

Die Befolgung der nötigen Vorsichtsmassregeln ist mit Kosten verbunden, welche den Betriebsfond belasten. Die Vernachlässigung der nötigen Vorsichtsmassregeln ist mit noch grösseren Kosten verbunden, welche die Wohlfahrtsfonds belasten, insbesondere die staatlichen oder berufsgenossenschaftlichen Unfallsversicherungen. Bei den Wien-Nussdorfer pneumatischen Fundierungen hätten, wie ich a. a. O. berichten konnte, die Unfallsversicherungs-Prämien nicht weniger als 55 Prozent des Einkommens eines jeden Arbeiters betragen müssen, um die Versicherungs-Anstalt schadlos zu halten. Es gibt diese Tatsache ein Bild der Gefahrengrösse, wenn wir uns vergegenwärtigen, dass die Prämien der Unfallversicherung im gewöhnlichen Leben einen nur sehr geringen Prozentsatz des Einkommens ausmachen und dass der höchste Unfallsversicherungsbetrag, den die Versicherungsanstalt von Betrieben der höchsten Gefahrenklasse einheben könnte, kaum 8 Prozent der Lohnsumme erreicht.

Die Niederlande haben sich unvergänglichen Ruhm in der Geschichte des Arbeiterschutzes gesichert. Allen Staaten voran haben sie Massnahmen vorgeschrieben, um die Gefahren der Caissonarbeit zu mindern. Das Gesetz vom 22. V. 1905 hat seine segensreiche Wirksamkeit bereits erwiesen. Ein grösseres Bauwerk, die Fundierung des westlichen Eisenbahnviadukts zu Amsterdam hat durch nahezu zwei Jahre täglich 50–100 Arbeiter in einem Ueberdrucke bis zu 2.1 Atmosphären beschäftigt. Kein Todesfall, kein Fall bleibender Invalidität hat sich ereignet. Harmlose Erkrankungen, allerdings an Zahl 228 betragend, wurden durch die in Kraft stehenden Vorschriften nicht verhütet (Wintgens, Kropveld, Verschuyl, van Thienen).

Dem Beispiele der Niederlande folgend, hat Frankreich 1908, das Staatsgebiet von Hamburg und jenes von New York 1909 Vorschriften erlassen.

Die Vereinigung für gesetzlichen Arbeiterschutz strebt die behördliche Regelung des Caissonsbetriebes in allen Ländern an.

Der beiliegende Entwurf, den ich heuer im Auftrage der österreichischen Arbeiterschutz-Gesellschaft verfasst habe, sucht von den Erfahrungen die ältesten und bewährtesten, von den Forschungsergebnissen die jüngsten und beweiskräftigsten zu verwerten. Der Gang unserer Erkenntnisse erklärt es, dass der Entwurf sich mehr an die guten, alten, nie durchgeführten Regulative Wagner's 1878 und Brennecke's 1884 anschliesst als an die modernen Vorschriften Heller-Mager-von Schrötter's.

Die Druckluftarbeit wird immer mehr als das Prototyp einer gefährlichen Beschäftigung anerkannt. Einem Verfahren gegenüber, welches mit unheimlicher Präzision vom Leben zum Tode, von bester Gesundheit zu immerwährendem Siechtum führen kann, wird das Aufsichtsrecht des Staates zur Aufsichtspflicht. Die gesetzliche Regelung und Verbesserung des Arbeiterschutzes im Caissonbetriebe ist eine notwendige und dankbare Aufgabe jedes Kulturstaates.

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[1] Neuere Literaturangaben bringt die in Druck befindliche 2. Auflage meiner "Hygiene der Arbeit in komprimierter Luft." Weyls Handbuch der Hygiene, 2. Auflage.

THE ACUTE EFFECTS OF CAISSON DISEASE.

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Of all the occupational diseases which follow in the train of advancing civilization, together with development of arts, sciences, and industries, none is of greater interest, none more dramatic in its manifestations, than the ofttimes tragic effects of the illness to which men are liable who work in compressed air in diving or in subaqueous construction of tunnels, jetties, foundations for bridges, and so forth.

A man in all the vigor of health and strength descends to his daily task in the river tunnel, enters the compressed air, works his regular shift of three or four hours, comes out through the air lock by the ordinary method of decompression, ascends to the street, and starts for his home, feeling perfectly well.

Fifteen minutes later, without the slightest warning, he is attacked with the most intense boring pains in his legs and abdomen, or,

again, he staggers and falls helpless to the ground, paralyzed from his waist down. Fortunate he is if efficient treatment be near at hand, and by recompression in the medical air lock his pains vanish, his paralysis disappears, and on the morrow he returns to his work as usual.

The evolution of theories and devices to enable man to subsist for a time under water begins with the age of Aristotle and Alexander the Great, and constitutes a fascinating study; but the first authentic mention of "caisson disease" is due to Trieger, the French engineer, who first successfully operated a practical caisson in 1839.

The material for this paper is mainly drawn from the writer's own experience of two and one-half years as a member of the medical staff in attendance during the construction of the East River tunnels from New York to Long Island City, the largest single enterprise ever attempted under compressed air, in which more than 10,000 men were employed and 3,692 cases of illness were reported by the medical director, Dr. F. L. Keays.[1]

To designate the train of symptoms resulting from work in compressed air various terms have been used, e. g., "caisson disease," "divers' palsy" "compressed-air illness or sickness," "bends," and so forth.

In an earlier paper [2] I have ventured to employ the term "aeropathy," as being more inclusive and, for philological reasons, more widely available in all languages, and this term I shall employ hereafter in this paper.

ETIOLOGY.

At the outset we will state our acceptance of the theory that gas emboli in the blood and body tissues are the direct cause of aeropathy symptoms, and a clear understanding of the etiology is essential to the correct interpretation of the "Protean" manifestations of this disease.

The animal experiments of Boyle in 1670 laid the foundation for this theory, and its elaboration by Hoppe-Seyler, Bert,[3] Von Schrötter, Silberstern, Leonard Hill,[2] and others has placed the gas-emboli theory in an impregnable position.

Practically all autopsies, if performed early, upon victims of an acute attack of this disease, show gas emboli in the veins and right heart.

All other theories may be dismissed at once, upon the ground that none of them accounts for the formation of a single bubble of gas in the body fluids, which happening we believe to be the one necessary factor in the etiology.

The fluids and tissues of a man working in compressed air become saturated with the gases of the atmosphere to a degree which depends upon (1) the amount of pressure (Dalton's law); (2) the length of exposure; (3) the vascularity and the absorptive ability of the individual tissue.

No symptoms ever develop while a man remains in the compressed air, no matter what the degree of pressure, nor length of exposure; hence we can state dogmatically that the disease is due solely to the ebullition of bubbles of gas (chiefly nitrogen), brought about by "decompression" which is so rapid that the gases can not be carried by the blood to the lungs and there gotten rid of gradually, as they have entered; consequently, they are set free as bubbles in the body tissues and fluids, with disastrous effects in many cases, forming emboli in the circulation or damaging tissues by the force of their expansion.

PHENOMENA OF COMPRESSION.

Certain interesting phenomena are noted during the act of compression, which are largely mechanical, and may be regarded as physiological; certainly they are in no sense symptoms of aeropathy.

(1) The rising pressure forces inward the ear-drum membrane, causing discomfort, acute pain, or even rupturing this structure unless the pressure be equalized by admitting air through the Eustachian tube, by Valsalva's method or an equivalent.

(2) Slight rise in body temperature and sweating occur, due to the heat generated by the compression of the air.

(3) The denser air offers a slight resistance to expiration and phonation. Whispering becomes impossible; and the lessened amplitude of vibration renders whistling difficult or impossible and, in such an attempt, the nonvibrating lips give a sensation of slight numbness.

(4) The voice loses its natural quality and sounds intensely nasal.

(5) A sense of exhilaration and an ease of movement is experienced, and it is claimed that compressed-air work increases the appetite.

Other phenomena of compression have been reported but are now generally discredited, thus:

Pallor of the skin and mucous membranes does not occur, unless it be from nervousness on the part of the man entering compressed air for the first time.

There is no lessening of the volume of the pulse, no constant alteration in the blood pressure, no constant change in the rate either of the pulse or respirations.[4,5,6]

The superficial veins do not collapse; the capillary circulation in a frog's foot continued unchanged. (Hill[2] and others.)

There is no demonstrable change in the urinary or sweat excretion.

Hearing is not affected.

PHENOMENA OF DECOMPRESSION.

Phenomena of decompression include chilling of the body, due to the falling temperature in the air lock, and one may at times note a crackling sound in the ears as the air escapes through the eustachian tubes.

SYMPTOMS OF AEROPATHY.

The symptoms of aeropathy proper occur only as a result of decompression and after its completion.

The time of onset is from within 15 minutes up to a few hours after decompression. Among the 3,692 cases at the East River tunnels about 50 per cent occurred within 30 minutes and 95 per cent within 3 hours; however, 1 per cent were delayed over 6 hours, and of these latter 4 isolated and somewhat doubtful cases were said to have occurred between 15 and 23 hours after decompression.[5]

The commonest types of symptoms are as follows:

(1) Pain is by far the commonest symptom, occurring in over 88 per cent of all cases, either as the only symptom or associated with others.

Its most frequent site is in the lower extremities (70 per cent), in the region of the knees, forcing the victim into an attitude which gives rise to the popular term, "bends" or "courbatures."

Next in frequency are pains in the upper extremities, about the elbows and shoulders, in 30 per cent.

Pains in the abdomen occurred in about 5 per cent of the cases, but were of greater significance than were pains in the extremities, in that they more often preceded or accompanied cases of severe prostration or paralysis.

(2) Vertigo, or, in the parlance of the workers, "staggers," was met with in over 5 per cent, and is explainable by the formation of bubbles in the labyrinth of the internal ear, or, when accompanied by nausea and vomiting, it may be due to cerebellar embolism.

(3) Cerebro-spinal cases, including transient or permanent paralyses, such as hemiplegia, paraplegia, loss of bladder and rectal control, represented 2.16 per cent.

(4) Dyspnœa, called "chokes," of a type resembling an asthmatic attack, occurred in over 1½ per cent, and may well be due to multiple small gas emboli in the pulmonary vessels; for were it of central nervous origin it would naturally be accompanied by other serious nerve disturbances, which is not the case.

(5) Prostration of moderate degree and associated with pains in some part of the body made up 1¼ per cent; and

(6) Collapse, with partial or complete unconsciousness, happened in about one-half per cent (0.46 per cent).

(7) Fatal cases were 20 in number, or 0.54 per cent, and occurred either with rapid onset of unconsciousness and collapse or with pains and prostration accompanied by nausea and vomiting or with paralyses, or from later complications of persistent paraplegia.

CLASSIFICATION OF SYMPTOMS (ACUTE).

The symptoms of aeropathy will vary with the anatomical part affected, with the amount of gas set free, and the consequent degree of disturbance of function.

Connective tissue, especially fat, with its peculiar ability of absorbing four times more nitrogen than other tissues and its poor blood supply, becomes desaturated more slowly than other body tissues, and it is found in practice that fat men are ill adapted to work in compressed air.

Proceeding therefore to tabulate symptoms with reference to the structures affected, we find:

Symptoms referable to the—

(1) *Nervous system.*—(*a*) Peripheral nerves: Pain occurring in the extremities or abdomen in over 88 per cent of all cases, without other evidence of spinal cord irritation except in a little over 2 per cent, must admittedly be due to peripheral irritation of nerves and nerve terminals by bubbles of gas in the nerve sheath, in fascial tissues, beneath the periosteum or in bone marrow.

Numbness, anaesthesia, and paraesthesia are doubtless capable of the same explanation.

One form of paraesthesia, called by the men "itch" or "prickles," is quite common, is distressing while it lasts, but is never of serious import. This may be explained, as Hill[2] does, as due to bubbles in the subcutaneous areolar tissue, but in my experience it is no more common in fat men than in thin men; it occurs especially when sweating has been less free, and it is usually at once relieved by a hot bath or sweating, all of which makes it more probable that it is caused by expanding bubbles in the sweat glands.

(*b*) Central nervous system.—Brain: Unconsciousness, stupor, and collapse may be due to cerebral gas embolism or resulting oedema, or are secondary to circulatory failure due to coronary or pulmonary embolism.

Cerebral gas embolism may also cause aphasia, incoherence of speech, ataxia, vomiting, vertigo, headaches, or such signs as hemiplegia, monoplegia, convulsions, nystagmus, and tongue deviations, depending upon what area is affected.

Actual tearing of nerve tissue and hemorrhage may occur by the expansion of bubbles of gas, resulting in organic lesions.

Spinal cord affections include paraplegia, monoplegia, loss of bladder and rectal control, partial paralyses, spasticity exaggerated, diminished or absent reflexes; anaesthesia, anaesthesia dolorosa; and, with hemorrhage into the cord, the symptoms may become permanent, and a true myelitis may develop.

Very frequently, however, there is only a temporary weakness and numbness of the legs, with or without retention of urine.

(2) *Special senses.*—(*a*) Eye, transient blindness, diplopia, and nystagmus may occur.

(*b*) Ear, performation of the drum membrane may occur, but only during compression, hence is not properly a symptom of aeropathy. Deafness and vertigo may follow the formation of bubbles in the labyrinth or hemorrhage in the same situation.

(3) *Vascular system.*—Gas emboli in the veins of the systemic and portal system, in the right heart, in the pulmonary and coronary vessels, have been found so regularly in animal experimentation and at autopsies upon fatal cases among men (provided the autopsy be performed within 20 hours after death from an acute attack) that this fact forms the whole basis of our understanding of the etiology of this disease.

The bluish "mottling" of the skin, seen over the chest and abdomen in some of the severer cases, is caused by embolism of the superficial veins, with consequent stasis.

Lymphatic obstruction by gas embolism is, doubtless, the explanation of the several instances of localized edema of a small area of an extremity.

(4) *Respiratory system.*—The symptom called "chokes" has been described above. In certain fatal cases there has been found edema of the lungs; also interstitial emphysema of the parenchyma.

(5) *Gastro-intestinal symptoms*, further than the epigastric pains and the nausea and vomiting above mentioned, are not encountered.

(6) *Internal organs*, such as the liver, spleen, and kidneys, do not give any acute signs, although at autopsy they may be found affected.

(7) *Sexual apparatus* is only affected as a result of spinal-cord injury, which may give rise to priapism, and so forth.

(8) *The bones, joints, and periosteum.*—In one case necrosis of the femur resulted apparently from thrombosis of the medullary artery. The deep-seated pains so frequently referred to the long bones of the extremities and to the joints may be due either to collections of expanding bubbles under the fascial planes or under the periosteum; or, as Hill[2] suggests, in the yellow marrow, which structure is rich in fat and deficient in circulation.

(9) *Skin and subcutaneous tissues.*—The symptoms of "itch" and the "mottling" of the skin have been described above. Subcutaneous emphysema, without trauma, is met with in a few cases during life and frequently in autopsies, especially along the course of the large veins of the extremities. Its presence as an accompaniment of contusions and punctured wounds I have several times demonstrated,

and it is doubtless due to the setting free of gas from the extravasated blood, for it is hardly likely that such an amount of compressed air could enter through the puncture.

(10) *Localized collections of gas*, aside from the small emboli scattered through the body, include the large collections found in the right side of the heart at autopsy (case cited below). At one autopsy which I witnessed there was a collection of about 5 cubic centimeters of gas beneath the mucosa of the jejunum. In two other cases I succeeded in aspirating about 1 cubic centimeter of gas from beneath the periosteum of the tibia, whose presence was evidenced by a soft cushionlike swelling in this area.[4]

(11) *Miscellany.*—In general, wounds bleed just as freely and heal quite as readily in the compressed air as in the normal atmosphere. Infections of the middle ear and of the sinuses which communicate with the nose are favored by the efforts of men to force open the Eustachian tubes during compression, which factor also accounts for most of the rather infrequent cases of epistaxis in caisson work. In use of the diving helmet, however, bursting of the air tube may cause epistaxis, ecchymoses, etc., by the cupping effect of sudden removal of pressure from the upper part of the body.[2]

Cystitis, pyelo-nephritis, myelitis, and meningitis may occur as the sequelæ of cord injury, but are not properly among the acute effects.

CONCLUSION.

In a paper so limited in time little more than an outline of the acute effects of aeropathy is possible. In conclusion, therefore, I would report what is, I believe, the first analysis ever made of the gases found in the right heart of a man who died from the effects of this disease, to wit:

On November 19, 1907, the author, with the assistance of Dr. J. E. McWhorter, collected 3.1 cubic centimeters of gas by aspiration from the right heart at the autopsy, 14 hours post mortem, of a man who died 1 hour after a 17-minute decompression, following 8 hours exposure to +30 pounds pressure. Upon analysis this gas yielded nitrogen, 80 per cent; CO_2, 20 per cent; which percentages are in accord with analyses made in animal experiments by various writers on this subject.

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[1] F. L. Keays: Compressed Air Illness. New York, 1909.

[2] Leonard Hill: Caisson Sickness. London, 1912.

[3] Paul Bert: La Pression Barométrique. Paris, 1878.

[4] Seward Erdman: Aeropathy, or Compressed Air Illness Among Tunnell Workers. Journ. A. M. A., Nov. 16, 1907, Vol. XLIX, pp. 1665–1670.

[5] Heller, Mager, and von Schrötter: Luftdruckerkrankungen. Wien, 1900.

[6] Harlow Brooks: A Study of Blood Pressure in Compressed Air Workers. Med. Record, May 25, 1907. N. Y.

[7] C. J. Aldrich: Compressed Air Illness, or Caisson Disease. Med. News, N. Y., Nov. 26, 1904.

THE LATE MANIFESTATIONS OF COMPRESSED-AIR DISEASE.

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In this paper attention will be called to the ailments met with in compressed-air workers years after the exposure and acute manifestations. The material is practically the same as that which formed the basis of the article on compressed-air disease in the Report of the Commission on Occupational Diseases of Illinois (published in Chicago, 1911). An abstract of this report, read before the Chicago Neurological Society,[1] is as follows:

> Some of the men examined had had their acute attacks many years ago; others during the present year. Of the 161 men, 87 had various affections of the ears, causing permanent impairment of hearing in 65 cases; 141 gave a history of "bends," that is, severe muscular and articular pains; 34 had paralysis, most generally transient and affecting the legs, although 3 men have permanent partial paralysis of one arm and 3 of both legs, and 11 present more or less chronic joint pain and stiffness. One of these men, who developed an affection of the hip immediately after working his second shift in compressed air 12 years ago, has been an invalid ever since and presents the typical X-ray picture of arthritis deformans. He had been in perfect health before these two exposures to compressed air. One man, with signs of caisson myelitis, had a spontaneous fracture of the patella 11 years after the acute attack, which had consisted of numbness in both lower extremities, followed by pain; 12 men now present signs of some degree of permanent cord disease; 13 were delirious or unconscious during the acute attack; 33 complained of vertigo as a prominent symptom; 6 of vomiting during the acute stage, and 11 of incontinence or retention of urine; 5 had numbness without paraylsis; 6 had "blind staggers," that is, labyrinthine vertigo with nystagmus; and 2 had "chokes." Several men gave a history of large swellings of the soft part of the chest wall or in the vicinity of joints. Bassoe had not seen them at this stage, but agrees with Heller, Mager, and Schrötter that the swellings are due to vasomotor disturbance of central origin—not to local liberation of gas (tumeurs gazeuses), as has been claimed by French writers. He considers the nitrogen-bubble theory of Paul Bert fully proved both by the observations on human beings and the abundant experimental work recorded in the literature. The cases treated by immediate "recompression" had fared much better than those not so treated.

In the spring of 1912 a number of these men were subjected to renewed and more thorough examination. They naturally group themselves into three classes, which will be taken up separately and illustrated by case records:

I. Cases in which spinal-cord symptoms predominate—caisson myelitis.

II. Cases of permanent joint affections, with the clinical and X-ray picture of arthritis deformans.

III. Cases of permanent ear affections.

Naturally, some men present symptoms belonging in two or all three of these classes, but, as a rule, one set of symptoms predominates.

CLASS I. CASES OF CAISSON MYELITIS.

GROUP A. CASES WITH SIGNS OF TROPHIC OSTEOARTHROPATHIES DEPENDENT ON THE CORD LESIONS.

CASE I (Illinois report, case 23).—*Attack of "bends," with numbness of legs and stiffness of knees, in 1898. Spontaneous fracture of patella in 1909. Porosis and atrophy of fragments. Fracture of external tuberosity of humerus in 1911. Signs of cord disease.*

Aged 40 years. Fourteen years ago he worked on Oak Street Water Tunnel, in eight-hour shifts. Pressure, 28 to 32 pounds. After working for a week, he had the first attack of "bends." Decompression, three and a half to five minutes. Five and a half hours later, taken with numbness and cold feeling in both lower extremities from the hips down, followed by severe pain for six or eight hours, and stiffness in the right knee. He returned to work in two days, and then the knee felt better, but it has never been well since. In January, 1909, on getting up from a chair, the right patella was fractured, and an abscess formed. He was laid up for five months. In August, 1909, he fell 4 feet and cut the skin over the right knee. On another occasion, on coming out from the lock, he had bleeding from the nose and ears. He returned to the lock and the trouble stopped. He has also worked on the Illinois Tunnel and the Four-Mile Water Tunnel without trouble. He denies syphilis, but admits gonorrhea. He states that from the time of the acute attack of "bends," until the patella was fractured, he had only slight pain.

Examination in October, 1910: Pupils normal. The right knee is stiff; there is a scar across it, and there is palpable evidence of an old fracture of the patella. Ankle jerks absent; left knee jerk absent; right knee jerk can not be tested on account of limitation of motion. On stroking the sole of the foot, extensor response of the right big toe is obtained, and flexor response on the left side. Sensation normal. No sphincter disturbance.

Dr. Hollis E. Potter took an X-ray picture of the right knee and reports the following findings: "Fracture of right patella at a point just below the middle of the bone. Diastasis of fragments of 2 inches. A third and smaller fragment lies between the two main portions. The lower fragment is elongated at the point of rupture. All surfaces of the fragments, as now seen, are rounded off, leaving no angles or corners. All fragments show porosis and bone atrophy."

In the spring of 1911 he fell on the floor, on his left hand, and sustained a fracture of the greater tuberosity of the humerus. He admits rather heavy drinking, which probably accounts for an enlargement of the liver, which was quite marked when he was reexamined in April, 1912. Then the right knee was found to be more freely movable, while there was slight limitation of motion at the right ankle. The knee and ankle jerks were now obtained on both sides, the former even exaggerated. The right knee jerk was stronger than the left, and the right-sided Babinski sign persisted. No ataxia. Sensation normal. Blood pressure equals 150 m. m. of mercury. Urine normal.

CASE II (Illinois report, case 59).—"*Bends" in right knee in 1890. Lame ever since. Looseness of patella with atrophy of bone. Disturbances of reflexes and sensation.*—(Cousin of Case I.) Aged 45 years. Twenty years ago he worked on the Four-Mile Tunnel, at pressure up to 25 pounds. He had several very light attacks of "bends" and then, after he had been in the tunnel, at pressure of 25 pounds, for about 25 minutes, he was taken with nosebleed, and, five minutes later, with bleeding from the left ear. He went out through the lock in one or two minutes, and, on coming out, bled from both ears. While still in the lock, he had severe pain in the left temple and the left side of the forehead. After coming out, the pain was less severe, but he was dizzy. Twenty-four hours later he was taken with severe pain in the right knee, which lasted for seven months. He was in the Cook County Hospital, and two other hospitals, on account of the pain, which later particularly involved the left knee and left arm. Twenty-seven months after the onset he went to work as an elevator man in the Cook County Hospital. He did this work for three months and gradually improved. Three years ago he tried to work in compressed air at Gary, Ind. The pressure was 17 pounds, and he only worked one shift, as he got a peculiar sensation in the left arm. He still limps, dragging the right leg. In the spring of every year, he has more pain, and he then often has noticed that the right patella appears to be very loose. The left arm is numb in the region of the elbow. He has had no sphincter disturbance. He works most of the time, but can only do light work.

The watch is heard at 2 inches in the left ear, at 4 inches in the right ear. Wrist jerks are absent; the elbow jerks diminished; abdominal reflex not obtained. The right cremasteric reflex is stronger than the left, the knee jerks are increased, the plantar reflexes normal. The right-ankle jerk is diminished; the left, not obtainable. Both tactile and pain sense are moderately diminished in both legs, especially on the outer surfaces. The right lower extremity is 2 inches shorter than the left, and the circumference of the right thigh is 2 inches less than that of the left, while the circumference of the right calf is only one-half inch less than that on the left side. The right patella is slightly more movable than the left.

On account of the looseness of the right patella, the patient was referred to Dr. Hollis E. Potter for X-ray examination of the right knee. Dr. Potter's report is as follows: "The noticeable feature is a lateral widening of the upper face of the tibia, allowing a projection of one-half inch of this bone beyond the articular surface of the femur. It is difficult to account for this, since all profiles of both bones are smooth and regular, excepting a slight roughening of the inner condyle of the femur on its articular surface, suggesting cartilaginous loss. Slight atrophy of patellar borders."

Many years ago he injured the right eye in a dynamite blast, and the right pupil has been dilated ever since. Formerly the pupils were equal and the eyes normal in every way, according to the patient's statement.

Case III (Illinois report, case 37).—*Repeated attacks of "bends" for 27 years. Paralysis and incontinence in 1910. Signs of cord disease. Islands of atrophy and sclerosis in tibia.*—Seen October 1, 1910. Aged 46 years. He has worked in compressed air in various places most of his life since he was 17 years of age. Had "bends," lightly, in New York and New Jersey; worse in Cleveland, where the pressure was 48 pounds and where he worked in two-hour shifts, at intervals of four hours. After exit in four minutes he was taken with severe pain in the legs and arms, and was in a hospital for four weeks. He could not stand high pressure well afterwards; got the "bends" again, and left Cleveland. When working on the Four-Mile Tunnel into Chicago, at pressure of 27 to 30 pounds, he had slight "bends" after coming out through lock in about three minutes, and he had to lay off three days on account of the pain. In 1910 he worked at Hibbing, Minn., where an ore shaft was sunk. Pressure, 38 to 40 pounds. After his first shift of two hours, on January 20, he came out through the lock in about one and a half minutes, although the posted order of the company was that the time should not be less than 15 minutes. But there was a "green" lock tender. Immediately after exit he had severe pain in the abdomen and extremities, could not walk, and at the same time the left eardrum was said to have ruptured, with bleeding from the ears. He was placed in the hospital lock, without relief; then he had a hot bath, and was placed in the hospital lock a second time. He was in the hospital for three weeks, and then stayed five weeks at the hotel unable to work. He could not walk for seven weeks after the onset, and had incontinence of urine and feces until a few months before being seen in October, 1910. Urination and defecation were still precipitate, and he still had some weakness and pain in the legs. He can not hear the watch on contact with the left ear; barely hears it with the right ear. Knee jerks normal or slightly exaggerated. Right ankle jerk absent (left not tested). He does not feel pin pricks in the legs and hands. He says that when examined at the hospital at Hibbing he could not feel pin pricks.

When seen again, in April, 1912, he had not been in compressed air since the previous examination. He has worked, but is troubled with pain in the right leg and occasional incontinence of urine and feces; of the former especially after drinking beer. The right leg sometimes "gives way" when he walks, but recovers after a brief rest. The right ankle is considerably stiffened, while there is normal range of motion in the other joints. There is now distinct analgesia only of the outer part of the left foot, and the outer aspect of the lower third of the left leg. No Romberg sign. Blood pressure equals 100 mm. of mercury.

X-ray examination by Dr. Hollis E. Potter fails to show any bony change to account for the stiffness of the right ankle. There is no change in the tibia within an inch of the ankle joint, but from this level and extending upward there are irregularly shaped islands of atrophy and of sclerosis in the interior of the bone. There is also mushrooming of the anterior portion of the astragalus into the scaphoid, resulting in flat foot.

GROUP B. VERY LIMITED PERSISTENT CORD LESIONS.

CASE IV (Illinois report, case 110).—*Two attacks in 1896. Permanent sensory loss in left ring and little fingers.*—Aged 52 years. About 1896 he worked for six months in compressed air at the Sixty-eighth Street Tunnel in Chicago. He had two attacks. The first one occurred after coming out from pressure of 20 pounds. He had severe bursting sensation in the head, nosebleed, ringing in the ears, and dizziness. On returning to compressed air he was considerably relieved, but, on coming out the second time, the ring and little fingers on the left hand became numb. He could move them, but they were evidently analgesic, as, four months later, a piece of flesh was accidentally torn out of the little finger without causing him any pain. The right heel also became numb in this attack, and remained so for about six months. He stayed away from work one week. The second attack occurred a month later, and consisted of similar sensations in the head. On returning to compressed air, he again improved. The condition of the affected fingers and heel was not changed by this attack. He lost two shifts. A few years later, he worked on the Oak Street Tunnel, and had no trouble, except that he was "blocked" a few times. He quit compressed-air work, and now works at a pumping station.

Examination in 1910 revealed diminished tactile, pain, and temperature sense of the left ring and little fingers and of the ulnar side of the hand and forearm, more so on the extensor surface. The wrist, elbow, knee, and ankle jerks were normal. The watch was heard at 8 inches on the left side, 12 inches on the right side, and he was then in good health.

When reexamined in June. 1912, he still complained of "sleepy feeling" in the same fingers and in the ulnar portion of the hand. The anæsthesia remained, and there was also loss of the sense of passive motion in the affected fingers.

Case V (Illinois report, case 107).—*Attack of pain in right hand and forearm in 1898. Persistent analgesic area on forearm.*—Aged 39 years. In 1898 he worked on the Sixty-eighth Street Tunnel, Chicago, and, after working three months, he had an attack while at work at pressure of 18 to 24 pounds. He was taken with pain in the fingers of the right hand, which ascended to the elbow and was very severe. He went out through the lock in three or four minutes, which was unusually slow, and then became dizzy and had ringing in the ears. The pain remained about the same and lasted for five weeks. He went to work after 10 weeks, but not in compressed air, until working on the Thirty-ninth Street Tunnel about three years later. The pressure here generally was 12 pounds and he had no trouble.

The right arm has been a little weak ever since the attack, and occasionally after a hard day's work there is a "stitching" pain in it. On examination in 1910 the arm reflexes and tactile sensation in the arms were normal, but there was an analgesic area in the inner half of the upper third of the anterior surface of the right forearm. Knee and ankle jerks increased without clonus. Watch heard at 4 inches in the left ear and 10 inches in the right ear.

When seen again, in March. 1912, he said he had been forced to give up his work as bricklayer's tender because heavy lifting would cause pain and subsequent "falling asleep" of the right arm from the elbow down.

Three other cases of this kind will be placed in Class II on account of the more important joint lesions (Cases XII, XIII, XV).

GROUP C. CASES OF ORDINARY MORE OR LESS EXTENSIVE "CAISSON MYELITIS."

Case VI (Illinois report, case 8).—*Onset in 1890. Persistent pain in the legs and precipitate micturition. Changes in the reflexes.*—Aged 54 years. Seen in July, 1910. He worked under compressed air on the Four-Mile Tunnel, Chicago, from 1890 to 1893, and had charge of the bricklaying. He had the "bends" three times. The first time after an 8-hour shift he came out from a pressure of 22 pounds in two or three minutes, although he had been advised by the engineer in charge to spend 10 minutes; but this precaution was seldom taken. In half an hour he was taken with severe pain in the knees, shoulders, and wrists, became dizzy, fell down on the street, and was picked up by a policeman, who thought he was drunk until informed by other workmen. He returned to work the next day. The second attack was similar, starting with pain in the knees, then he was dizzy and slightly dazed. He returned to work the next day. The third attack came on one-half hour after less than five minutes' decompressions, following an 8-hour shift in pressure of 33 to 35 pounds. He was taken with dizziness and pain in the knees. Was taken home, stayed in bed for about 36 hours; was not clear mentally; sat up in bed and "mumbled." He returned to work in a week, but the legs were weak and aching and the back was painful on stooping. No sphincter disturbance at first. but in a few weeks developed precipitate urination, which grew worse and became permanent. He had to give up work and was a patient in the Cook County Hospital from February to May. 1895. His case then seemed to have attracted considerable attention. He has never recovered, has suffered much pain, and walks very poorly. Had not been able to work at his trade since then, and has been idle most of the time, but at the time of examination had an easy position as night watchman. He was in perfect health before working in compressed air, but has been a heavy drinker. On examination there is found opacity of the left cornea. The right pupil reacts to light. Hearing in the right ears is defective, the watch only being heard on contact. In the left ear it is heard at 3 inches. He can not get the right heel down to the floor. except when the left heel is raised. The left knee jerk is considerably exaggerated, the right about normal. Both ankle jerks are diminished, the left more so. Arm reflexes normal. Sensation normal. He died suddenly in 1911.

Case VII (Illinois report, case 155).—*Four attacks of "bends," one associated with transient paralysis of both legs and retention of urine. Increased reflexes and sensory disturbance.*

A young man, 24 years old, was seen in November, 1910, at St. Louis, where he was working in caissons for the new bridge. He had worked in compressed air since 1903. The first attack was in 1907, and came on after working at a pressure of 22 pounds. The decompression lasted 7 minutes, and 10 minutes later he was taken with severe pain in the left knee. He was well in 2 days, and had the second attack 6 months later, after coming out from a pressure of 28 pounds, in 10 minutes. He had pain across the abdomen, and "knots" formed in the abdominal muscles. Both legs were paralyzed for 2 hours, and he had to be catheterized for 2 weeks. For the next 6 months, there was some dribbling of urine, and ever since the legs "fall asleep" easily. He returned to work in a month and worked two 3-hour shifts at a pressure of 30 pounds in one day. After coming out from the second half, in 10 or 12 minutes, he was immediately seized with pain in the abdomen. He took a bath, and was then suddenly taken with extreme dizziness, tinnitus, and nausea. He could not see plainly; everything seemed to whirl around. He did not vomit until a physician gave him medicine, which he thinks was an emetic. He was in the hospital for 10 days, could walk after 4 days, but some dizziness remained for two months. Tinnitus and complete deafness were present the first 3 days, and hearing has never been normal since. Then he had a couple of attacks of "bends" while working on two bridges in Arkansas. The first one was slight, and affected the hips: the second one was rather severe, affected the left arm, and he did not fully recover for a week. Since February, 1910, he worked on the bridge at St. Louis, and in April, while working two daily 2-hour shifts at a pressure of 40 pounds, he had an attack. Decompression lasted 15 minutes, following which he was taken with pain in the left hip, which lasted all night, and was finally relieved in the hospital lock, but he had to go in and out four times. Aside from these definite attacks he has frequently had some burning in the skin of the abdomen and of the left arm after coming out. This has occurred as a regular thing when the pressure was high. He has also frequently been dizzy for about 10 minutes after coming out.

Watch heard in right ear at 3 feet; in the left ear not heard on contact, but C–2 tuning fork heard. Both knee and ankle jerks are exaggerated and there is reduced pain sensation in the left leg.

In this connection the following case is of interest, as showing how repeated attacks, with severe acute symptoms, may fail to produce any permanent disease:

Case VIII (Illinois report, case 147).—Aged 36 years; foreman. Seen at St. Louis in November, 1910, where the following record was made: Has worked in compressed air for 10 years, much of the time as foreman or superintendent; has made his own rules, and has stayed much longer in, and come out more quickly from, the compressed air than the ordinary laborers are permitted to do.

The first attack occurred in Texas, in 1905. He stayed in a caisson, which had sunk, for 1½ hours, at a pressure of 53 pounds, and came out in about 5 minutes. Then stood out in the cold air for awhile, and, after 15 minutes, suddenly became paralyzed from the waist down. He had no pain, could not move the legs for 8 days, had to be catheterized for 10 days, and required enemas to move the bowels. He then improved rapidly, but had severe pain in the knees and ankles for 4 days after recovering from the paralysis. He had full control of the bladder after the retention ceased, but there was burning on micturition for some time. The catheter had not been boiled, and had been passed by a "sand hog." The next attack occurred in Arkansas, one year ago, after he had spent 12 consecutive hours in a pressure of 40 pounds. He came out as rapidly as the valve would permit, and had severe pain in the right shoulder for 2 days. He had no trouble when working on the Traction bridge at St. Louis, but has had two attacks while working on the new bridge since last February. The first one occurred on the Illinois side last September. He spent 7 hours at a pressure of 51½ pounds, and came out in 3½ minutes, while the time prescribed for the men was 35 to 40 minutes. Five hours later, when in bed, he was taken with slight pain in the knees, and 1 hour afterwards became paralyzed from the waist down. He was placed in the hospital lock 45 minutes after the onset of paralysis, and movement returned in 35 minutes. He stayed in the hospital lock for about 18 hours, and then was perfectly well, and returned to work. The second attack also occurred on the Illinois side on October 25. He stayed in a pressure of 45 pounds for several hours, came out in 3 to 5 minutes, when, half an hour later, he was taken with pain in the right shoulder. He used hot applications without any benefit, and 2 hours later he went to the hospital lock, where he remained for 17 hours, during which he had no relief at all, and, after coming out, he was worse than before. The arm is still weak and hurts a little. There was no swelling. Reflexes and sensation in both arms normal. Knee jerks brisk.

CLASS II. CASES OF PERMANENT JOINT DISEASE OF THE TYPE OF ARTHRITIS DEFORMANS.

In the course of this investigation, several cases were met with in which chronic arthritis of one or more joints had developed as a sequel of "bends" in the vicinity of the joints affected. The histories are so explicit on the point of the origin of the joint trouble in attacks of articular pain immediately following exposure to compressed air, that it seems that an etiologic relationship must exist. In some of the cases (XII, XIII, XV), acute cord symptoms as well as persistent ones were present, so as to make it possible that we are dealing with the osteoarthropathies previously considered, while, in others, it seems simpler and more reasonable to assume that the joint changes are the result of trauma to the articular structures by the local liberation of air, a well-recognized and common phenomenon.

CASE IX (Illinois report, case 47).—*Typical arthritis deformans of right hip. Onset in 1899, after working only two shifts.*

Aged 69 years; carpenter. Twenty years ago he worked on the Four-Mile Tunnel in Chicago without trouble. Eleven years ago he did some carpenter work in the Oak Street Tunnel, and worked two 8-hour shifts under pressure of about 30 pounds, from which he came out rapidly. On the way home from the last one he got pains in the legs, which became extremely severe and lasted all night. He says that he was blue all over the body, and that the physician could not feel his pulse. The blueness disappeared after rubbing the skin. He went to work in 4 days, but the legs were weak, especially the right one. He has walked lame ever since, on account of pain, which is chiefly felt in the right groin, and comes on especially when he starts walking. A year after the onset, he saw the late Dr. Christian Fenger, who put on an extension apparatus for 10 weeks. Then he felt worse, and had to use crutches for a year. He has not worked since this time. He never had any rheumatism, and was in perfect health before this occurrence. The knee jerks are brisk, the ankle jerks normal. Sensation and plantar reflex in the right leg normal. He had no sphincter disturbance, but now has to get up nights to urinate. There is an apparent lengthening of the right leg, which he says has been present ever since the extension apparatus was used.

Dr. Hollis E. Potter took an X-ray picture of the right hip, and reports the findings as follows: "All changes are compatible with an arthritis deformans of the hip joint, namely: The head of the femur is flattened and mushroomed; the neck of the femur appears shorter and wider; cartilaginous space decreased; osteophytes laid down at edges of cartilage, acetabulum, and head of femur."

The above notes were made in October, 1910. When last seen, in May, 1912, the condition of the hip remained the same. The distance from the anterior superior spine to the inner malleolus was the same on both sides; but that from the umbilicus to the inner malleolus, was 1.5 centimeters greater on the right side. There was limitation of motion in the right hip in all directions.

CASE X (Illinois report, case 115).—*Attack of "bends" in 1901, at once followed by pain in the right knee and, a couple of years later, by pain and stiffness of the right hip. Typical advanced arthritis deformans of the latter.*

Aged 48 years. In 1901, he worked on the Thirty-ninth Street Tunnel without trouble. Then in Cincinnati for 3 months in 1902. His first shift was 6 hours, at a pressure of 50 pounds. He came out through 2 locks, spending 5 minutes altogether. One and a half hours later he was taken with severe pain in the right knee, chiefly located at the inside of the patella. It was severe for 3 days. Neither hospital lock nor a bathtub was available. He has had more or less pain in the right knee ever since. He became unable to bend the knee fully, and could walk only a few blocks. He worked as a bricklayer until 1905, and since then has been a masonry inspector for the city. He has been in compressed air occasionally, but has had no further attack. Two or three years after the actute attack he also developed pain in the right hip, and this joint gradually became stiff. He has been considerably better during the last one and a half years, and ascribed the improvement to massage. Examination revealed marked limitation of motion in the right hip. The knee and ankle jerks are exaggerated, slightly more so on the right side. Sensation in the lower extremities is normal, but he complains of occasional sensation of "pins and needles" in the soles of the feet, and sometimes the fingers become white and feel a little numb. When standing long, the pain in the hip and knee gets worse, and the thigh feels numb. X-ray picture of the hip taken by Dr. Max Reichmann, in 1912, shows the joint partly obliterated by bony hypertrophy along the acetabular margin and at the base of the head of the femur.

There is plastic overgrowth of bone at the upper margin of the neck. There is slight upward wandering of the acetabulum, compatible with shortening of one-half inch. The condition is typical of advanced arthritis deformans of the hypertrophic type, secondary to an atrophic state.

CASE XI (Illinois report, case 72).—*Attacks of bends and vertigo in 1905. Since then, repeated joint swellings, X-ray findings typical of arthritis deformans in knees and ankles. Areas of atrophy and sclerosis of bone in right fibula.*

Aged 41 years. In 1905 he worked for nearly a year as timekeeper at the East Boston Tunnel. Pressure variable; maximum, 26 pounds. After working 10 weeks he had the first attack after coming out from a 4-hour shift at 26 pounds in 8 or 10 minutes. Immediately after exit he was taken with dizziness, bleeding from nose, ears, and eyes, pain in the knees and ankles, and across the small of the back. He was taken home in a carriage and stayed in bed for four weeks, during which the pain was continuous and very severe, especially in the back. He could move the legs, but could not get up on account of the pain. Urination was slow, followed by dribbling, and has remained so. Sexual power not affected. Some dizziness and tinnitus; the latter, especially in the right ear, has persisted. He returned to work in 6 weeks, but could do very little. Two weeks later, after coming out in 10 or 12 minutes from a pressure of 24 pounds, he was again taken with dizziness, nosebleed, and pain in the kness and back. He stayed in bed 3 weeks. After another week he went to work, but never returned to compressed air, and has worked as a salesman and insurance agent. He has become generally nervous, suffers considerably from pain in the back and knees, headache, and tinnitus, the latter particularly during colds. Occasionally there is swelling of the knees and ankles, all of which joints became swollen within a few hours of exit from the lock at the time of attack. These joints now become swollen about once a month, usually all four at a time, and the swelling lasts from a few days to two weeks. The watch is heard in the right ear at 6 inches, left at 12 inches. Knee and ankle jerks normal. There is much tenderness about the knees, and a grating is felt when the patellæ are moved.

When last seen, in June, 1912, he stated that he had been in bed for a month during the winter on account of pain and swelling of the knees, ankles, and hands. Grating in the knees, especially the right one, was still present.

X-ray pictures of the right knee, as interpreted by Dr. Hollis E. Potter, show deposition of bone at the upper anterior surface of the patella, "lipping" of the tibia anteriorly, and external displacement of the tibia on the femur, the joint surfaces not being in perfect apposition. The right ankle shows fragments of bone at the extreme lower end of the fibula, but it is not clear whether they are derived from the fibula, astragalus, or ossified ligaments. The lower half inch of the fibula shows irregular areas of atrophy and sclerosis. The left ankle shows little change, merely slight atrophy of the extreme tip and inner surface of the fibula adjacent to the astragalus. The hands show no changes.

Case XII (Illinois report, case 111).—*Attack of "bends" in 1896, both shoulders affected. Now pain and stiffness of left shoulder. Anesthesia over left scapula.—X ray shows arthritis deformans of left shoulder.*

Aged 43 years. First seen in October, 1910. About 20 years ago worked as a bricklayer on the Four-Mile Tunnel, Chicago. Pressure, 18 to 21 pounds. He worked 7½ hours a day at one stretch. One attack occurred after coming out in 3 to 3½ minutes. He first had twitching in the muscles of both arms, and half an hour later severe pain in the same locality, which lasted for about 8 hours. The next attack occurred in 1896, after he had been working for 2 weeks on the Cleveland Tunnel. He came out in about 2½ minutes from a pressure of 34 pounds, in which he had worked continuously for 9 hours. At once he was taken with severe pain in the chest and both shoulders. He went back in the lock for 2 hours, during which he was relieved, but, after coming out the second time in 4 or 5 minutes the pain returned. Then he was again relieved by staying in a warm bath for 6 hours, but the pain returned and lasted about 4 days. He then returned to work, and had no pain while in compressed air, but ever since this attack, when not in compressed air, he has frequently had twitchings and pain about both shoulders and across the chest.

The trouble is now diminishing, and he has it only occasionally, when resting after a hard day's work. It is now felt only in the left shoulder. He is now a sewer inspector. He had no rheumatism of any kind before this attack. He denies syphilis, but admits gonorrhea. Examination reveals considerable limitation of movement in the left shoulder. He can not raise the arm fully to the vertical position. The arm reflexes are normal. There is a triangular area of tactile anesthesia above the spine of the left scapula. The temperature sense is also diminished in this area and downward to the level of the angle of the scapula. Pain sense is lost in the triangular area, but is not affected as far downward as is the temperature sense. Sensation on the arm and chest normal.

When reexamined in 1912 the findings were practically the same, the anesthetic area extending from the edge of the trapezius nearly to the angle of the scapula.

X-ray examination of the shoulder by Dr. Max Reichmann shows the head of the humerus to be enlarged and porotic. There is great irregularity in the joint surfaces, and the rim of the glenoid cavity is greatly overgrown with bone.

Case XIII (Illinois report, case 5).—*Pain in legs and paralysis in 1897. Limitation of motion in hips. Articular pains since onset. Altered reflexes.*

Aged 48 years. Bricklayer. In 1897 he worked in compressed air during the construction of a water tunnel at Rockford, Ill. The pressure was 39 pounds, and he worked in two long periods. He thinks decompression lasted about five minutes, as only 1½-inch valve was used. After coming out from his third shift he was immediately taken with pain in the legs, walked to his boarding house, became paralyzed in the legs, and was taken to a hospital in Rockford, where he remained for 3 days, during which there was much pain. He was then taken back to Chicago, but could not walk at all for 6 months. During this time he could move the legs a little, but every movement caused pain, and the muscles often felt "as if tied in a knot." There was no sphincter disturbance at first, but about a year and a half later micturition was slow and rather painful for a time. He has never been entirely free from pain since the acute attack, and had to give up bricklaying altogether. The pain affects the knees, thighs, and hips, and is generally worse in the autumn of every year. He has done a little work as inspector for the city and some light work in tunnels, but recently he has been quite lame and unable to do any work. Of late he has had considerable edema of the legs.

The pupils are equal and react normally. The knee jerks are slightly increased. The ankle jerks can not be obtained, while the wrist and elbow jerks are increased. Abdominal and cremaster reflexes normal. Sensation normal. Considerable stiffness, pain, and limitation of movement in both hips. The strength in the muscles of the legs is fair. Heart normal. The urine contains considerable albumen.

Case XIV (Illinois report, case 58).—*In 1899 attack of pain in legs; vertigo. Rupture of ear drum and persistent deafness; left knee still painful.*

Aged 43. Seen in October, 1910. He first worked under pressure of 9 to 15 pounds, on the Illinois Tunnel in 1899. On one occasion, when pressure was 19 pounds, he had a bursting sensation in the ears while in the lock and had bleeding from both ears, nose, mouth, and eyes. He became extremely dizzy and partly unconscious; was carried out and taken to the Polyclinic Hospital, where he stayed for 3 days, during which time he was very dizzy. The left drum was found to be ruptured. The bleeding lasted for about an hour and a half, when there was purulent discharge from the left ear for 6 or 7 months. He also had pain in the limbs and back and had to be helped to raise himself in bed. He had much backache for 4 months, and for 2 years there was tinnitus, like the ringing of bells. Hearing in the left ear has been lost ever since. Three years ago he worked in compressed air at Clinton, Iowa, but he had to give it up on account of dizziness and queer feeling in the head. Both knees, especially the left, have been quite stiff ever since his first attack. He had then returned to work in 6 months, shoveling earth, but had to quit in less than a week on account of pain in the knees, arms, and back. The left knee is now painful on passive movement and on tapping the patella. The knee jerks are normal. The left ear is totally deaf; not even a C–2 tuning fork is heard. Watch heard in right ear at 1 foot.

Case XV (Illinois report, case 160).—*Ear trouble since "blocked" in 1898. Three attacks of "bends" in 1901. Still often pain in knees and ankles. X ray of left knee shows islands of sclerosis in tibia and thickening of surface of tibia. Diminished sensation and decreased reflexes in legs.*

Aged 35 years. First seen in October, 1910. In 1898 he worked on Illinois Tunnel; pressure, 18 pounds. Bled from right ear when going through lock the first time. He returned to work the next day, but had tinnitus for a week, and the right ear has been slightly deaf ever since. Whenever he had a cold this ear would trouble him when he went into compressed air. In 1901 he worked for one year in Cleveland (Ohio) Water Tunnel, where he had three attacks. The first one occurred after he had been working for 3 weeks. One hour after very rapid decompression, following an 8-hour shift at 37 pounds, he was taken with pain in both legs, "like a sword tearing up and down the flesh," which lasted 18 hours. He was out of his head on account of the pain; "would have killed himself if he had had the chance." He was given plenty of hot whisky and returned to work in 5 days. Two other men were affected at the same time. The second attack occurred 3 weeks later after quick decompression following an 8-hour shift at 27 pounds. He returned to the lock on account of severe pains similar to those of the first attack and improved rapidly. Went out again slowly and was able to return to work the next day. Four weeks later he had the third attack, which came on less than 1 hour after coming out rapidly from a pressure of 27 pounds. He had to go to a cold room, although, according to the rules, a warm one should have been provided. He had pain like that of the previous attacks.

In 1907, he worked for three months at Clinton, Iowa. In the course of the work, the pressure was gradually raised to 27 pounds. After coming out from a four-hour shift, with wet feet, on account of leaking boots, he was taken in three-quarters of an hour with the same kind of pain as before. He returned to the lock, remained one hour, came out slowly, and was well. He did not return to work there, but, in 1909, he worked on the Northwestern Depot, Chicago, at pressure of about 18 pounds. He was "blocked" a few times, but had no other trouble.

He now works in open caissons, and is in good health, with the exception that the legs are often stiff in damp weather. He never had this trouble before the attack of "bends."

Watch heard at 1½ inches in the right ear; 4 inches in the left.

When seen again, in June, 1912, he still complained of pain in the knees and ankles in changeable weather, "in the same place where he had the bends." The knee and ankle jerks were sluggish, and both tactile and pain sense seemed to be reduced from the knees down. The patient has seven children, and denies veneral disease.

Dr. Hollis E. Potter made X-ray examination of the knees. Two inches below the left knee joint there are changes in the spongy tissue of the tibia in the shape of irregularly branching or stellate islands of sclerosis. Dr. Potter is of the opinion that this appearance is caused by a reconstruction of the bone, following an atrophic process. There is also a bulging thickening in the surface of the tibia just below the head of the fibula. The right knee shows no change.

GROUP III. EAR AFFECTIONS.

As stated, 87 of the 161 men gave a history of ear affections, and 65 have more or less impairment of hearing. Thirty-three complained of dizziness. Rupture of the drum, which, according to the large experience of Koch[2] and of Chrabrostin[3] is rare, was said to have occurred in our cases III and XIV, related elsewhere in this paper, and in one other case. However, we only have the patients' statements that they were so informed by doctors, who might have drawn the erroneous conclusion that hemorrhage from the meatus indicated rupture of the drum. Such hemorrhage had taken place in a large number of cases.

Eight of the men with more or less marked permanent deafness were referred to Dr. G. W. Boot for otological examination. In every one a diagnosis of labyrinthine deafness was arrived at. In five of these men marked nasal obstruction was present, caused by deflected septum or enlarged turbinates, which furnishes a reason for the liability of these men to be "blocked" on entering the caissons. Four of them state distinctly that the ear symptoms came on after decompression, which harmonizes with the labyrinthine character of the deafness. However, according to Heller, Mager, and Schrötter,[4] the general experience has been that "decompression is of no importance in caisson workers when the ears are healthy." The presence of nasal obstruction in so many of our men, therefore, becomes significant, as the ears may have been diseased beforehand, and as such obstruction would render equalization of pressure by means of free passage of air through the Eustachian tubes extremely difficult.

Case XVI.—*Eighteen years ago partly "blocked" on entrance. After decompression, pain in ear, vomiting, vertigo, total deafness for a time. Persistent tinnitus and partial deafness.*—Aged 36 years. In 1904 he was partly "blocked" on entering pressure of 27 pounds. Two and a half hours after coming out he was taken with pain in the left ear, vomiting, vertigo, and delirium. He was delirious for several days, during which there was considerable bleeding from the left ear, and, later, discharge of pus. There was total deafness at first, but soon hearing was partly restored. He has never been in compressed air since then. Left-sided tinnitus has persisted, and he often feels dizzy. Dr. Boot examined him in June, 1912, and reports:

"Whisper in right ear heard at 30 cm.; in left ear, loud whisper heard only close to the ear. Bone conduction much shortened. Weber to the left. Low limit: Hears 32 with each ear. C-4 shortened in the left ear. Upper limit: R., 20,000; L., 19,000. Throat normal. Nasal septum deflected to the right. Right tympanic membrane lusterless, position normal. Left retracted, luster good. Irrigation of the right ear with cold water gives rotary and horizontal nystagmus to the left. Irrigation of the left ear with cold water gives rotary and horizontal nystagmus to the right, chiefly rotary. Hearing improved by inflation. Diagnosis: Tubal occlusion. Labyrinthine deafness."

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[1] Journal of Nervous and Mental Diseases, June, 1911.

[2] Koch: Festschr. Friedr. Wilhelmsinst., Berlin, 1895.

[3] Chrabrostin: Official report on work under water to Russian Navy Department, 1882. Cited after Heller, Mager, and Schrötter: Die Luftdruckerkrankungen.

[4] Loc. cit., p. 1003.

CAISSON DISEASE AND ITS PREVENTION.

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The prevention of caisson disease is a very important subject to engineers and contractors, as the State regulations imposed with this object in view are becoming more and more restrictive.

Caisson disease has resulted in an ever-increasing cost of operation by bringing about reduced hours of labor, increased pay, and a limited supply of labor.

The hours of labor are reduced to minimize the chances of disease, the pay is increased to overcome the fear of disease, and the supply of labor is limited by medical exclusion to prevent disease.

It is therefore evident that if caisson disease had been understood and prevented, that at least two of these factors, the decreased hours and the increased pay, would not have been so necessary.

There is nothing novel in working in compressed air, as we were born under these conditions, and live under a varying air pressure which, for those who travel over mountainous regions, may vary as much as 4 or 5 pounds per square inch.

The greatest range of air pressure on the earth's surface is from the top of Mount Everest to the bottom of No. 3 shaft of Calumet and Hecla mines, or from about 5 pounds absolute pressure to 17½ pounds, or a range of 12½ pounds, as shown on figure 1.

The pressure of the atmosphere at sea level is 14.7 pounds, and this pressure is taken as zero in steam or air pressure gauges registering pressures above atmosphere, generally referred to as gauge pressure or +, while the pressure of the atmosphere or chamber above a perfect vacuum is called the absolute pressure.

A drop in absolute pressure from 17½ pounds to 5 pounds is a fall of 71½ per cent, which is no safer than in dropping from 51½ pounds absolute to 14.7 pounds, or a 71½ per cent fall. That is to say, it is possible, on the earth's surface, to encounter as hazardous conditions as obtain in working in an air pressure of 36¾ pounds gauge.

If one could be elevated from the earth's surface to a height of 40,000 feet in a few minutes, caisson disease would be almost certain, and no doubt some of the unaccountable accidents in flying are due to the effects of decompression caused by a too rapid ascent.

Until balloons were invented, it was possible to reach rarified atmosphere only by climbing, which, even by railroad, is comparatively slow; so that, although mountain sickness is common, aggravated cases of caisson disease or "bends" are not on record.

It is now generally accepted that caisson disease is caused by the nitrogen of the air becoming absorbed or dissolved by the blood and tissues when under air pressure, and becoming liberated as bubbles during and after decompression.

Under atmospheric pressure, the blood and tissues carry a definite weight of absorbed nitrogen, and if the air pressure is increased they will absorb a definite increase of nitrogen in proportion to the pressure, while if the pressure is decreased they can only hold a decreased quantity of nitrogen and the surplus is given off in bubbles. Just in precisely the same manner as the water under pressure in a bottle of aerated water carries a definite quantity of carbonic-acid gas in proportion to that pressure, and, if the cork is released gently, the pressure falls and gradually the surplus gas in the water escapes until equilibrium is again restored. If, on the other hand, the cork is

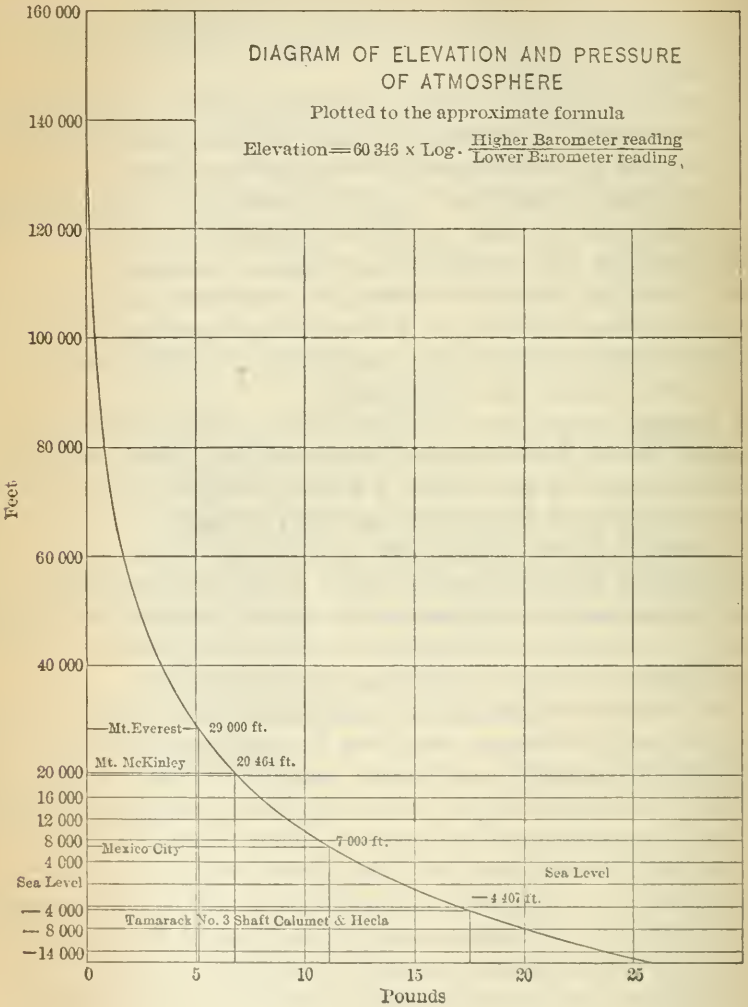

FIG. 1.

allowed to blow off, the sudden reduction of pressure causes the absorbed gas to escape suddenly, frothing up the water in doing so. Similar changes occur in the blood and tissues of a man on decompressing.

The earliest successful attempts to cure the "bends" consisted in restoring the original pressure to prevent the expanding bubbles from tearing the tissues, and these attempts were made instinctively by the men themselves. Following out the same thought, the bubbles which caused the pain were prevented from reappearing by reducing the pressure gradually.

Paul Bert was the pioneer who first suggested the application of this principle, not only to the cure of caisson disease, but also to its prevention.

For years the workmen cured themselves by returning to the caisson, and Dr. Smith, of New York, suggested the substitution of a recompression chamber which Mr. Moir, without knowledge of Dr. Smith's prior suggestion, put into use by building the first recompression chamber or medical airlock in 1890 for the old Hudson Tunnel. The medical airlocks used on the East River tunnels of the Pennsylvania Railroad were also designed by Mr. Moir, and are shown in figure 2.

The success of the medical airlock on the Hudson Tunnel reduced the death rate due to caisson disease from 25 to 1 per cent, and that, combined with the increased knowledge of the disease, kept the death rate on the Pennsylvania East River tunnels down to nineteen hundredths of 1 per cent, showing that a considerable advance had been made in the cure and prevention of the disease. From the observed effects of slow decompression in the medical airlock, combined with the suggestions of Paul Bert, it has gradually become apparent that the rate of decompression is of the utmost importance.

The writer had the good fortune to be the managing engineer for S. Pearson & Son (Inc.), the contractors on the four East River tunnels for the Pennsylvania Railroad, on which there were at one time as many as 10 headings under air pressures varying from 15 to over 40 pounds gauge pressure. The maximum number of men employed, including surfacemen, was 2,500, and more than 4,000 cases of caisson disease were cared for.

Some valuable results were obtained from this great undertaking, as the medical force was very desirous of studying this interesting subject in all its phases, and they have written excellent papers which are valuable contributions to our understanding of caisson disease.

The results of our experience show that, although it is not possible, from a practical point of view, to altogether prevent caisson disease, yet it can be kept within control.

Starting the work with the benefit of all the literature on the subject, and the great experience that Mr. Alfred Noble had gained under very high air pressures, combined with Mr. Moir's experience

MEDICAL AIR LOCK USED IN THE EAST RIVER TUNNELS OF THE PENNSYLVANIA TUNNEL AND TERMINAL RAILROAD

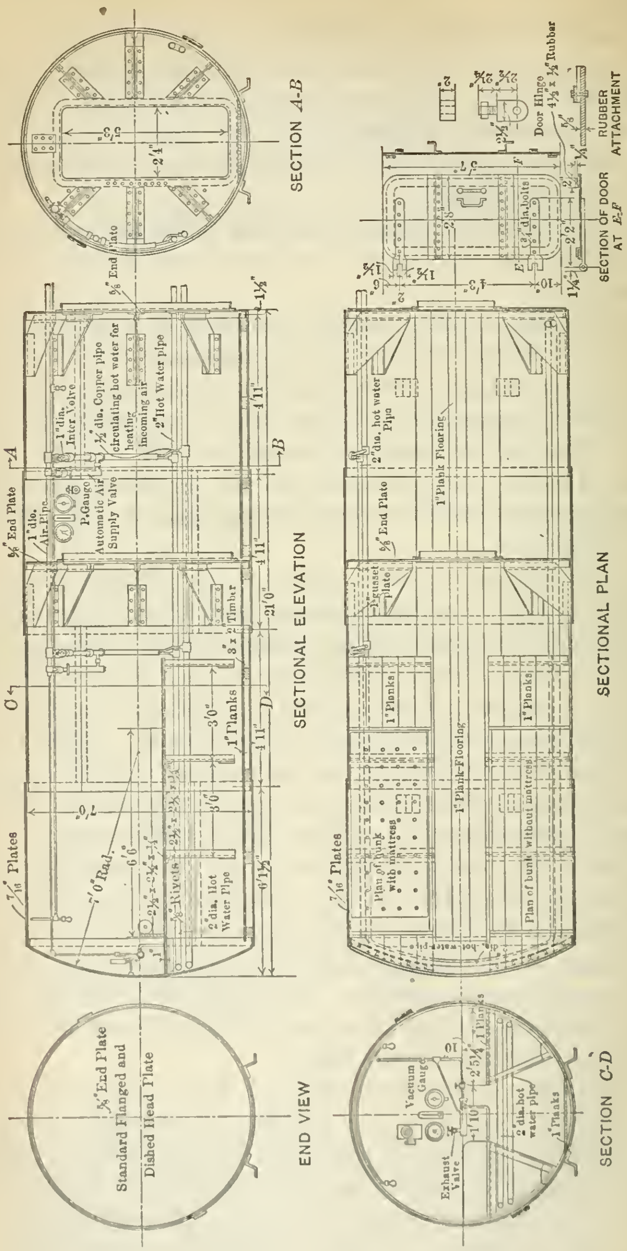

Fig. 2.

in the caissons of the Forth Bridge, the old Hudson Tunnel, and the Blackwall Tunnel, we considered we were well equipped for the work.

Regulations for the guidance of the men (Appendix 1) were printed in six languages, and posted on the works, and we gradually developed a system, by the time the pressure reached 36 pounds, which was approximately as follows:

Under the supervision of our chief medical officer, Dr. Frederick L. Keays, each applicant was examined physically by the medical officers (of which there were five), and, if sound, he with others was tested in a tunnel under pressure for 1½ hours under the care of a competent man. After decompressing, in 15 minutes he was again examined, and if no bad results were noticeable, he was allowed to go to work on the next shift for one-half a spell, and, if no symptoms developed, he was allowed to complete the remaining spell.

The shifts consisted of eight hours in air pressure up to 32 pounds gauge pressure, divided into spells by an interval of half an hour for lunch in atmosphere, or between locks at a lower pressure.

Above 32 pounds gauge pressure, the shift consisted of 3 hours work in air, 3 hours off in atmosphere, resting, and 3 hours work in air, which was in force up to 42 pounds pressure, above which the pressure never rose.

After completing the shift, the men were decompressed in large airlocks by the lock tender or foreman for a period of 15 minutes for pressures up to 35 pounds, and, in order to make the decompression automatically at a regular predetermined speed, decompression valves (fig. 3) were fitted in each lock.

In order to insure that the men who entered the air chamber were duly certified by the medical officers, each workman wore in sight a brass shield bearing a number under which he was registered by the doctor and the timekeeper.

Number checkers were stationed at the tunnel entrances, who booked the number of each man and refused admittance to anyone who had not a doctor's pass. These same number takers booked the time for decompressing, and the numbers of the men coming out, and reported directly to the writer, so that the rule of 15 minutes for decompression was strictly enforced. Hot coffee was provided free for the men, and warm dressing rooms were connected by covered passages with the elevators and the doctor's office, where the medical airlocks were located. The greatest number of fatal cases of "bends" occurred before all these regulations were enforced, and before the tunnels had progressed far enough to permit of two sets of airlocks with differential pressure—but, even after everything possible was done, fatal cases occurred.

It was not until after Dr. Haldane's investigations for the British Admiralty had demonstrated that a diver could descend in 210 feet of salt water, or 92.4 pounds gauge pressure, and, after decompressing by the stage method, would suffer no ill effects, that we were able to work in high pressures without fatal cases resulting.

Dr. Haldane's description of his work in conjunction with Dr. Boycott and Lieut. Damant is most interesting.

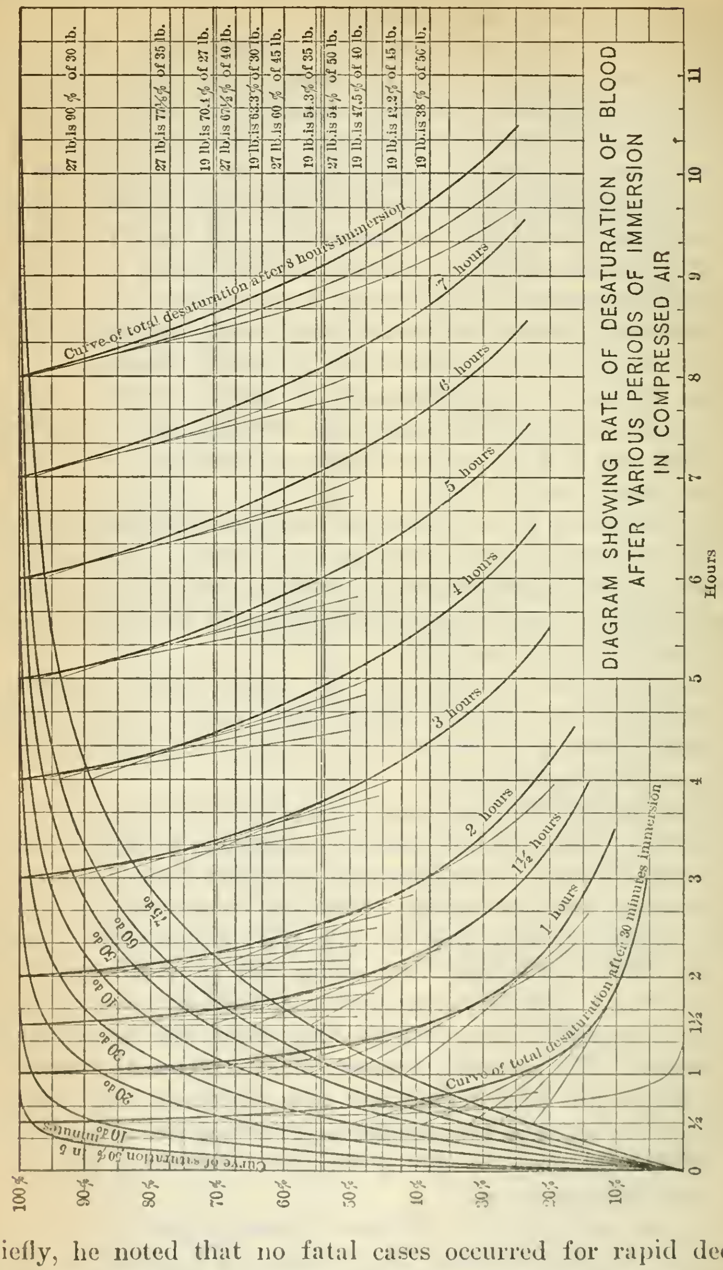

FIG. 3.

Briefly, he noted that no fatal cases occurred for rapid decompression up to 19 pounds gauge pressure, or 2.3 atmosphere absolute, and concluded that it was safe to decompress rapidly to 44 per cent.

of the absolute pressure—to be conservative, he calls this 50 per cent— and if, after reaching 50 per cent of the absolute pressure, the decompression continues slowly enough to keep the maximum air saturation of the body not more than 2.3 times the pressure in the airlock, there will never be any danger.

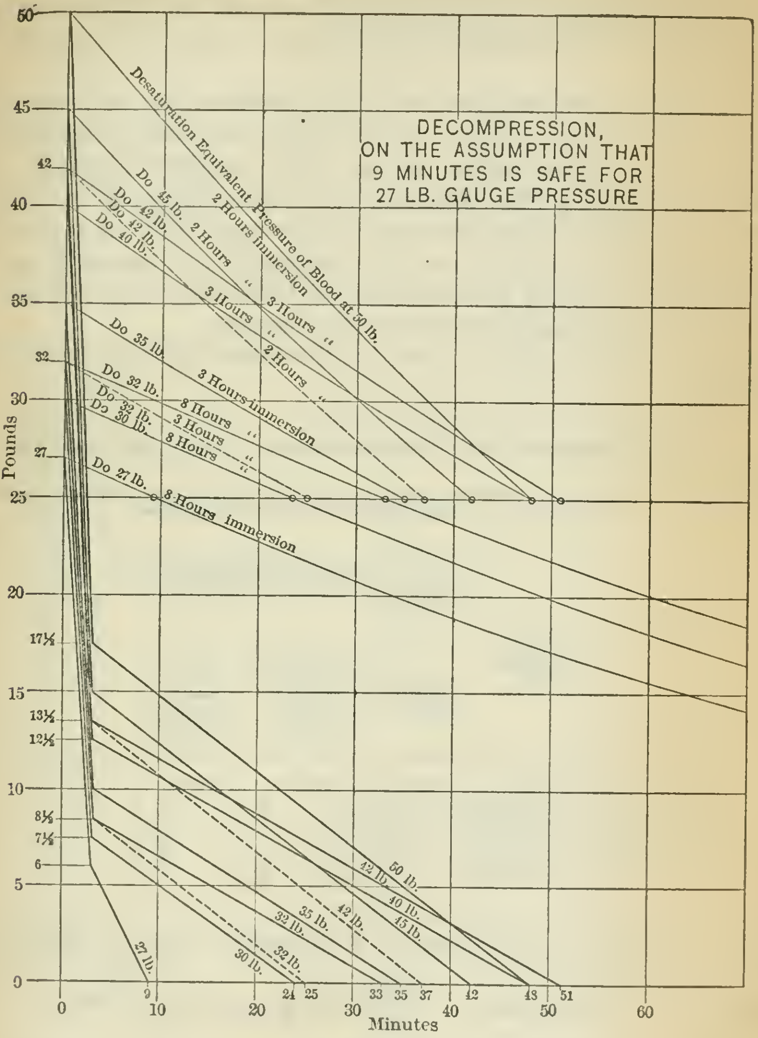

FIG. 5.

After many experiments on goats and men, Dr. Haldane concluded that the blood and tissues saturate and desaturate at the same rate in relation to the difference in pressure, and, from Dr. Haldane's results, the writer has plotted fig. 5, which shows the rate of saturation of various parts of the body which absorb nitrogen at rates varying from 50 per cent in 5 minutes to 50 per cent in 75 minutes.

On the same chart are shown the combined rates of desaturation for all parts of the body after periods of immersion varying from 30 minutes to 8 hours.

This diagram might be called the "sand hogs" chart.

On this basis it will be seen that 90 per cent saturation does not take place until after four hours' immersion for the slowest parts of the body, while the quickest parts become saturated 100 per cent in 40 minutes.

Dr. Haldane contends that the air is absorbed by the blood as it passes over the lung surface, and as it circulates through the body it gives up part of its charge of air to the unsaturated tissues and flesh and receives a fresh charge of air at each passage over the lung surface. So that, where the circulation is rapid and the number of blood vessels high for the mass, the saturation will be rapid, and in the same way, during desaturation, the blood will carry off the air and give it up on passing over the lung surface.

From his observations he drew up the following table for caisson workers:

TABLE 1.—*Dr. Haldane's rate of decompression in caisson and tunnel works.*

[Extract from report of a committee appointed by the Lords of the Admiralty on deep-water diving, August, 1907; Eyre & Spottiswoode.]

Working pressure per square inch.	Number of minutes for each pound of decompression after the first rapid stage.		
	After first 3-hour exposure.	After second or third 3-hour exposure, showing an interval for a meal.	After 6 hours or more of continuous exposure.
Pounds.	*Minutes.*	*Minutes.*	*Minutes.*
18–20	2	3	5
21–24	3	5	7
25–29	5	7	8
30–34	6	7	9
35–39	7	8	9
40–45	7	8	9

For example, if the pressure is 40 pounds gauge, decompress rapidly in 3 minutes to $\frac{40+15}{2}=27\frac{1}{2}$ pounds absolute, or 12½ pounds gauge; then take 7 minutes for each pound remaining, or 87.5 minutes, plus 3 minutes=90½ minutes in all. On the upper diagram of figure 6 the writer has plotted this graphically, which shows that the absolute pressure in the airlock is never allowed to fall to less than 44 per cent of the pressure in the blood.

Dr. Haldane suggests that, where possible, a portion of the tunnel should be maintained at a constant pressure of half the absolute pressure in the working chamber, and that the men decompress to this pressure in three minutes, and continue in this intermediate or

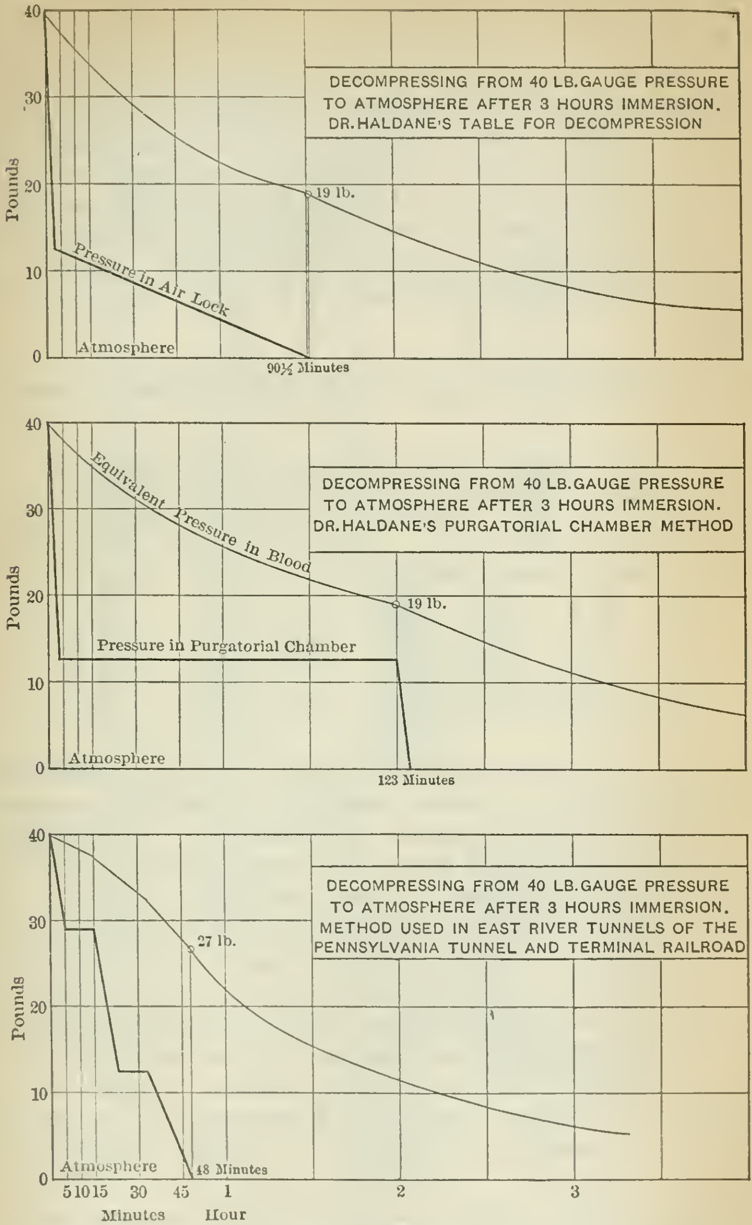

FIG. 6.

"purgatorial" chamber until the pressure in the blood falls to 19 pounds gauge, and then come out in three minutes. It is obvious that this will take longer than in the previous method and the middle diagram of figure 6 shows this graphically, the time required being 123 minutes.

It will be noticed that Dr. Haldane bases his theory on the fact that no fatal cases have occurred below 19 pounds gauge pressure, and, as he has proved his case for very deep diving, the writer concluded that as only a very few cases of death are recorded up to 25 pounds pressure, and in his experience, none below 29 pounds, it was reasonably probable that a system of decompressing which never allowed the pressure in the airlock to fall to less than 37 per cent of the maximum air saturation of the body, would meet the case from a practical point of view, as the times suggested by Dr. Haldane are very long, especially when applied to small locks and caissons.

Figure 7 was therefore plotted and Table 2 was drawn up from the diagram.

TABLE 2.—*Decompression table based on 25 pounds maximum air saturation of body on emerging.*

Gauge pressure	Reduce pressure in 3 minutes to—	Total time in airlock after 8 hours work.	Total time in airlock after 3 hours work.	Total time in airlock after 2 hours work.	Maximum air saturation of body on emerging.
Pounds.	*Pounds.*	*Minutes.*	*Minutes.*	*Minutes.*	*Pounds.*
27	6	9	....	....	25
30	7½	24	....	....	25
32	8½	33	25	....	25
35	10	....	35	....	25
40	12½	....	48	....	25
42	13½	....	51	37	25
45	15	....	....	42	25
50	17½	....	....	48	25

Before this table was drawn up, and some little time after reading Dr. Haldane's paper, it became necessary to raise the pressure in the tunnels to 40 pounds gauge. Fortunately, it was possible to make the men pass through three sets of airlocks, and, without fully understanding Dr. Haldane's theory, we tried to apply it. The men were ordered to take 5 minutes in the first lock, decompressing from 40 pounds to 29 pounds; then followed a walk of 1,000 feet in 29 pounds, which required about 10 minutes, including waiting for the airlock and the stragglers. Eight minutes were spent in the second airlock, where the pressure fell from 29 pounds to 12½ pounds, or half the original absolute pressure; another walk of 1,000 feet, or 10 minutes, elapsed at this pressure, and the third lock reduced the pressure to atmosphere in 15 minutes, or 48 minutes in all.

The lower diagram on figure 6 shows that the maximum air saturation of the body in the men, on emerging to the atmosphere, was 27 pounds gauge, so that they did what seems to be the equivalent of coming out of 27 pounds air pressure instantaneously, and no severe or fatal cases resulted under these conditions. Three hundred and thirty men were employed for 36 days, working 3 hours on, 3 hours off, and 3 hours on, representing over 23.000 individual decompressions without a mishap.

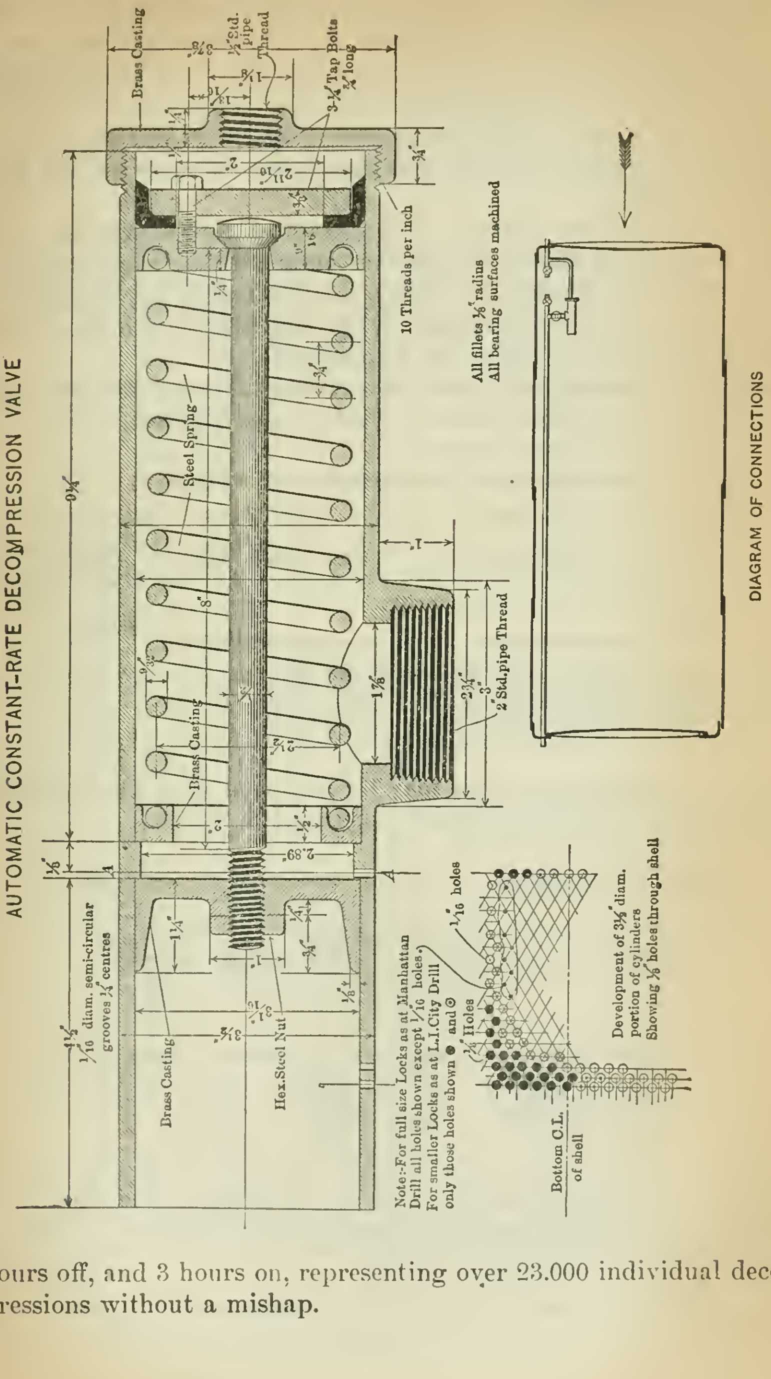
AUTOMATIC CONSTANT-RATE DECOMPRESSION VALVE

DIAGRAM OF CONNECTIONS

Brass Casting
½" Std. pipe Thread
3-¼" Tap Bolts ¾" long
10 Threads per inch
All fillets ⅛" radius
All bearing surfaces machined
Steel Spring
Brass Casting
2" Std. pipe Thread
Hex. Steel Nut
Brass Casting
1/16 diam. semi-circular grooves ¼" centres
Note:-For full size Locks as at Manhattan Drill all holes shown except 1/16 holes. For smaller Locks as at L.I. City Drill only those holes shown ● and ⊙
1/16 holes
⅛" Holes
Bottom C.L. of shell
Development of 3½" diam. portion of cylinders Showing ⅛" holes through shell
9¼"
8"
2.89"
1⅞"
2¾"
3"
3⅝"
1"
¾"
1½"
⅝"

FIG. 7.

It is true that only seasoned air workers were used at this high pressure, but, even so, it was a great improvement on our previous experience. If we had decompressed on the basis of Table 2, we would have still required 48 minutes, but the maximum air saturation in the body would have been reduced to 25 pounds gauge pressure, instead of 27 pounds.

While the writer would recommend Table 2, it is difficult for a number of engineers, doctors, and contractors to agree on any such lengths of time.

The commissioner of labor of the State of New York, Mr. Williams, called upon those interested in compressed-air work to submit their views to enable him to draft a law for regulating compressed-air works, and, with his permission, the suggestions of 21 men interested in this work are shown on Appendix 2.

Instead of embodying these recommendations in the new law, however, the regulations shown in Table 3 were adopted.

TABLE 3.—*New York State law for air work.*

Gauge pressure.	Time under pressure.	Interval between spells.	Uniform decompression.
Pounds.			*Minutes.*
0–28	8 hours less interval	30 consecutive minutes spent in open air.	18⅔
28–35.99	2 spells of 3 hours each	At least 1 hour	24
36–41.99	2 spells of 2 hours each	At least 2 hours	42
42–45.99	2 spells of 1½ hours each	At least 3 hours	46
46–49.99	2 spells of 1 hour each	At least 4 hours	50

In order that this new law may be compared with the suggested stage method in Table 2, these are compared in Table 4.

TABLE 4.—*Comparison of uniform and stage decompression.*

Tunnel pressure (gauge).	Time worked.	Uniform decompression (New York State law).	Maximum air saturation of body on emerging.	Stage compression (based on Table 2).	Maximum air saturation of body on emerging.
Pounds.	*Hours.*	*Minutes.*	*Pounds.*	*Minutes.*	*Pounds.*
28	3¾ and 3¾	18⅔	25.70	14	25
36	3 and 3	24	30.25	36	25
41.99	2 and 2	42	31.25	37	25
45.99	1½ and 1½	46	32.00	35	25
50	1 and 1	50	32.50	33	25

The law, while remaining as above for tunnels, has since been modified as regards decompression for caissons, as shown in Table 5, and goes into effect September 1, 1912.

The Air Workers' Union stipulate the times of work in caissons:

3¾ and 3¾ hours	To 22 pounds pressure
3 and 3 hours	To 33 pounds pressure
2 and 2 hours	To 35 pounds pressure
1½ and 1½ hours	To 40 pounds pressure
⅔ and ⅔ hour	To 45 pounds pressure

Table 5.—*Time of decompression for caissons, New York State law.*

	Time of decompression (in minutes).
Up to 10 pounds pressure	1
Up to 15 pounds pressure	2
Up to 20 pounds pressure	5
Up to 25 pounds pressure	10
Up to 30 pounds pressure	12
Up to 36 pounds pressure	15
Up to 40 pounds pressure	20
Up to 50 pounds pressure	25

It will be seen that the new law, which is based on uniform decompression, compares very unfavorably with the stage method, requiring generally much longer time to decompress and leaving a higher degree of saturation in the body. In other words, it is inconsistent in requiring 6 minutes for 9 pounds pressure and permitting what appears to be the equivalent of instantaneous decompression from 32.5 pounds.

What has always puzzled the writer is that a physically perfect man may continue working in high pressures daily without being subject to the disease and one day, under apparently similar conditions, he is attacked with a fatal case.

It seems logical to assume that some change takes place in the ability of the body to free itself of air bubbles in cases where strong men have worked daily for months under high air pressure without any symptoms; then, under precisely the same conditions, to all appearances, have suddenly succumbed to a severe attack of "bends," the blood on post-mortem examination being found frothed up with air bubbles.

The writer is too ignorant of physiology to know the possible changes that may take place in the blood and tissues of the body, but he suggested to one member of the medical staff of the East River tunnels that a valuable discovery might result from an investigation of the capacity of blood and tissue to absorb and give off nitrogen when in different conditions such as acid and alkaline, or with different relative numbers of red and white corpuscles, with various kinds of germs in the blood, and any other change that could be thought of.

It is fairly safe to assume, in these strange cases, that some change has taken place in the body, somehow, that it has a greater capacity for absorbing air, and that it gives it off more quickly than normally, in fact, too quickly for the body to get rid of it without damage.

Some time ago, the writer was very much interested to read that it was accepted by some of the medical profession that a man's mental condition produced changes in the secretions of the body, anger or fear producing noticeable changes which may possibly make one susceptible to caisson disease, in the same way that fear of yellow fever makes a man more susceptible to the disease. The writer noticed that the men who declared that caisson disease could not hurt them were singularly free from it. One superintendent, in particular, who insisted on coming out from all pressures with a 3-inch valve full open, never, as far as we know, had caisson disease.

This side of the question might well repay investigation.

Dr. Leonard Hill read a most interesting paper on "Compressed-air illness" before the British Association for the Advancement of Science at Sheffield, in 1910, and calls attention to the fact that the unstudied conditions which control bubble formation in supersaturated solutions are of the first importance.

He has proved, by his experiments on animals, that the varying percentage of fat in blood, chyle, liver, and the gaseous contents of the guts, are factors of importance; ill health, a debauch, and rich feeding modify these conditions.

In conclusion, he says, for caisson workers, that one stage at +15 pounds would suffice up to +50 pounds, and suggests that exercise and oxygen can be used to shorten the pause at +15.

He suggests a pause of 15 minutes at +10 pounds for +30 pounds working pressure, and 30 minutes at +15 pounds for +45 pounds working pressure, and says that this would probably suffice, so long as a medical air lock for recompression is at hand.

There is no doubt that much can yet be discovered by painstaking investigations, such as Dr. Hill and Dr. Haldane have already undertaken, and it would be a great help to the engineering profession if the International Congress on Hygiene and Demography could draw up a table for decompression within practical bounds, as a guide for future legislation.

APPENDIX 1.—*Pennsylvania East River tunnels regulations for men working in compressed air.*

1. All men must be examined by the medical officer before commencing work in compressed air, and must not enter the air lock until passed by him. His advice should be taken in all cases of illness or accident, which should be reported to him immediately.

2. All men must wear the doctor's pass badge where it can be seen by the timekeeper and lock tender.

3. No man should enter the air lock when sick or with an empty stomach.

4. After an attack of illness all men must report to the medical officer before returning to work in the tunnels.

5. No nuisance will be permitted in the tunnels. A water-closet on the surface is provided for the use of workmen. The bladder should be relieved before entering the tunnels, and all workers are strongly advised to see that their bowels are opened every day.

6. All men are advised to use intoxicating liquors sparingly or, better, not at all, and to drink water sparingly while in the tunnels.

7. Get fully 7 hours' sleep every 24 hours, if possible.

8. While in the lock, as the pressure is raised, it is recommended to clear the passage between the ears and throat by continual swallowing.

9. After coming out of the lock all men are advised to drink warm coffee freely, and to put on dry warm woolen clothing.

10. Avoid exposure to cold, and do not exercise unduly for one hour after leaving the lock.

11. Smoking in compressed air is dangerous and not permitted.

By order:

S. PEARSON & SON (INC.).

The above regulations are written in the following languages: English, German, Italian, Slavic, Hungarian, Polish.

APPENDIX 2.—*Proposed rules to be observed in work under compressed air.*

[Submitted to the Commissioner of Labor of the State of New York by twenty-one engineers, doctors, and contractors.]

1. *Medical examination.*—Before being allowed to start work in compressed air, all men should be examined and pronounced physically fit by the medical officer. In the event of a man being absent from work for more than three days owing to a sickness, he shall not resume work in compressed air until he has been reexamined and passed. When a man is suffering from any ailment he should report himself to the medical officer, whose advice he shall follow.

2. No alcoholic liquors will be allowed on the work.

3. The workmen shall be supplied with hot coffee free of charge.

4. The contractors will also provide for the men: Warm dressing rooms, bathroom with hot water, medical air lock.

5. *Analysis of air.*—Sufficient air shall be pumped into tunnel heading so that the percentage of CO_2 shall not be greater generally than one-tenth of 1 per cent above that of the air being compressed, and, in order to insure good ventilation, the air-supply pipes shall be carried as near to the face as may be practicable and necessary.

6. Persons working in compressed air must be able to communicate with the power plant on the surface at any time through suitable signal apparatus.

7. *Periods to be worked in various pressures.*—Up to 20 pounds gauge pressure, two 5-hour shifts at the face may be worked. From 20 up to 32 pounds gauge pressure, 8-hour shifts may be worked, with half an hour off for lunch. From 32 to 40 pounds gauge pressure, six hours at the face shall be worked, divided into two shifts of 3 hours each.

The periods to be taken for coming out of the various pressures shall be as follows:

One-stage decompression.—15 pounds gauge pressure, 1 to 3 minutes; 20 pounds gauge pressure, 3 to 4 minutes; 25 pounds gauge pressure, 5 to 8 minutes; 30

pounds gauge pressure, 10 to 15 minutes; 35 pounds gauge pressure, 15 to 20 minutes; 40 pounds gauge pressure, 25 to 30 minutes.

Two-stage decompression.—25 pounds gauge pressure (outer lock), 3 to 4 minutes; 30 pounds gauge pressure (outer lock), 6 to 8 minutes, with 5-minute interval between locks; 35 pounds gauge pressure (outer lock), 8 to 10 minutes, with 10-minute interval between locks; 40 pounds gauge pressure (outer lock), 12 to 15 minutes, with 15-minute interval between locks.

Pressure between locks to be approximately half the gauge pressure at the face.

The men will be held responsible for the due observance of the above rules.

DISCUSSION.

Dr. JULIUS GRINKER, Chicago: Regarding the remote effects of caisson disease, my experience extends only to spinal-cord diseases, in which I failed to see any improvement at all. In the cord, the pathology is practically that of embolism and thrombosis of blood vessels and the prognosis is usually bad, in contradistinction to the conditions such as Menier's disease which Prof. Frankl-Hochwart states have improved after years. Here, as elsewhere, the rule holds good that once the cord is destroyed, it remains permanently so.

TUESDAY AFTERNOON, SEPTEMBER 24, 1912.

THE EFFECTS OF EXPOSURE TO INTENSE HEAT ON THE WORKING ORGANISM.

Surg. Charles N. Fiske, United States Navy.

The navy has been consulted, I take it, in the matter of affections caused by heat and other attending conditions of the atmosphere in which its men work, because this class of disability has attracted attention in the public press and in occasional medical reports, either in time of war or in the course of cruises, in which the reading public is more or less interested by reason of prostrations and deaths being noted in published dispatches.

The accompanying statistical table records but 20 deaths and 32 invalidings from the service on account of heat stroke during the past 35 years, and the damage curve would indicate that heat prostration has been of comparatively little importance to the service as a whole; however, from the excerpts from sanitary reports of naval medical officers to follow, and the fact that considerable numbers of cases have on occasion jeopardized the strategic or diplomatic mission of a particular warship, the deep concern of the immediate hygienist will appear to be justified.

Heat prostrations were coeval with the "new Navy" of the past quarter century which found its beginning in the famous "white squadron;" correspondingly as that early class of all steam-propelled cruisers and gunboats has been retired, and its lessons in sanitation, and notably in ventilation, have been used profitably in the design and equipment of all but the earliest class of battleships and armored cruisers, the factor of heat stroke in the Navy has assumed relatively a very low value during the past few years.

Naval hygienists who have agitated changes in construction, arrangement, and ventilation of ships will represent that the service has largely solved the problem, while other observers will, with perhaps equally good reason, maintain that the difficulty has solved itself on account of smaller boilers and more economical leads of steam pipes and arrangements of pumps in the engine rooms of large ships. The latter view, however, is refuted by the still lower location of dynamo and steering-engine compartments, and, in the main, it will be evident that improved facilities for ventilation, whether natural or artificial, have achieved the subsidence of heat prostration. It is only when a radically new type of ship is placed in service that faulty and inadequate ventilation any longer occasions suffering and disability from undue atmospheric heat and humidity, as has recently been shown to occur on the first ships of the *Dreadnaught* type.

At their worst, heat affections have developed only on isolated occasions, and then only on comparatively few ships, and, in the absence of severe cases, many have doubtless been so trivial that they have hardly been recognized as of such a nature.

This statement must prepare the physiologists and pathologists among you who look for some apology or explanation for the naval surgeons' not making more definite contributions and exact observations relating to the Navy's fairly typical cases of heat exhaustion; it is perhaps thought that with their training, time, equipment, and peculiar opportunity to study the condition at its inception, something more than a mere compilation of general data should be available from the reports of naval surgeons for this paper. Such versatility, however, as the wide range of duties demands of naval medical officers, together with the lack of experience and apparatus to make the precise observations which would enable physiological study to withstand criticism, and the uncertainty of having the cases which nearly always occur under the unusual and unanticipated conditions on a ship in the Tropics, remote from laboratories, as well as the fact that these occasions are likely to find the doctor most busy, preclude the contributions for which we all seek, and which should be more practicable near steel mills, for instance, where cases may frequently be expected, and where they may be provided for such study.

The perusal of literature of disorders attributed to heat tends first to confuse the student as to nomenclature and terminology and almost hopelessly as to etiology. In the naval reports comparatively few titles have been used; probably fewer than if more had been available on the printed classification, and save for the quotations from the text of the reports themselves little dependence can be had upon just what train of symptoms a title was used to cover some 15 years ago, when heat affections were most prevalent in the Navy. For these reasons I have combined in the table all heat cases without regard to prevailing nosology.

One of the earliest references to heat prostration in the firerooms of ships, published by an American naval surgeon, is the following by Medical Inspector A. L. Gihon in his Naval Hygiene of 1872:

> The symptoms of insolation often occur among men not exposed to the direct rays of the sun—in the fireroom of steamers, on board the monitor class of armored vessels, in small, ill-ventilated cells. Dr. Kitchen informed me that while surgeon of the monitor *Dictator* it was common for men to be brought to him for treatment with coma, stertorous breathing, great heat of skin, full, quick pulse, and often convulsions. The cause was manifestly enough the

exhausting labors of a watch in the fireroom, where the temperature averaged 145° F., and where the ventilation was exceedingly defective, air that had been already respired being repeatedly returned. Maclean states that "insolation has frequently been observed on board ship, but almost always under conditions similar to those in barracks—that is, where overcrowding and impure air added to the influence of excessive heat. Insolation is not uncommon on board the mail steamers in the Red Sea in the months of August and September. It has been observed that most of the cases occurred while the sufferers were in the horizontal position in their ill-ventilated cabins," and he quotes the following: "Assuredly," says Dr. Butler, surgeon of the Third Cavalry, "those barracks most crowded, least ventilated, and worst provided with punkahs and other appliances to moderate excessive heat furnished the greatest number of fatal cases. Surg. Longmore, of the Nineteenth Regiment, notes that one-third of his cases and nearly half the deaths occurred in one company of the regiment quartered in the barrack which was manifestly the worst conditioned as to ventilation, and indeed in every sanitary requirement. M. Bassier, a surgeon in the French navy, reports that the man-of-war brig *Le Lynx*, cruising off Cadiz, in the month of August, had 18 cases of insolation out of a crew of 78 men. The heat was excessive (91–95° F.) and much aggravated by calms. The ship was overcrowded, offering little space for the berthing of the crew. M. Boudin quotes the case of the French man-of-war *Duquesne*, which, while at Rio de Janeiro, had 100 cases of insolation out of a crew of 600 men. Most of the men were attacked, not when exposed to the direct heat of the sun, but at night when in the recumbent position—that is, when breathing not only a hot and suffocating but also an impure air."

The works of Surg. Joseph Wilson, United States Navy, 1870, Medical Directors T. J. Turner, 1879, and A. Gorgas, 1897, and Medical Inspector H. G. Beyer, 1908, include but passing references to heat affections.

Medical Inspector J. D. Gatewood, in his Naval Hygiene, 1909, writes:

About 90 per cent of all troubles ascribed to heat come from a part of the service—the engineer force in cruising ships—serving under conditions that put a large load on the kidneys, while depriving them of the fluid necessary to flush themselves properly. The result is a great concentration of irritating urine and perhaps even anuria, if, while the body is bathed in warm sweat, there is a sudden checking of perspiration and rapid chilling of bodies under ventilators or fans. If during the year 1905 all the firemen and coal passers had been at sea the entire time, there would have been about 200 admissions for heat troubles from each 1,000 firemen and coal passers so employed, and in the year 1899 about 400, other conditions remaining the same.

The intensity has relation, however, to atmospheric conditions while under way, the course of the ship in relation to wind, high outside temperature with high relative humidity, and relative state of calm producing the maximum result. The hearts and kidneys and stamina of men, if much speed is maintained, are then greatly tried, especially if new men, some perhaps not well selected, are working as coal passers. It would therefore seem that in a general way tropical cruising, especially in our summer months, and an increasing percentage of recruits in the engineer force, tend to that condition in the service known as heat prostration. For instance, the records show that in 1898, when, owing to the Spanish-American War, there were relatively a large number of recruits and several summer months of general tropical cruising, though chiefly at reduced speed, the admission ratio for cruising ships was 29.4. At present the nature of the so-called heat prostrations in firerooms is not well understood. It appears that when men are working in hot air they are able to perform their duties without much distress when the standing of the wet-bulb thermometer is not much above 81° F., but when that bulb approaches 86° to 88° F. the disinclination to work becomes very marked. However, the form of heat prostration may not be due to the direct condition of contained air as shown by thermometer readings, but may be precipitated by rapid variations of skin temperature incident to exposure to drafts under ventilators in natural ventilation or to currents incident to assisted or forced drafts when applied to a fireroom already containing men who have been subjected to very high temperatures.

At any rate it has seemed that the tendency to heat prostration has become quite marked at times just after assisted draft has been started. It may be considered that if firerooms were kept under assisted draft the cases of heat cramps would be greatly diminished, but that the use of assisted draft only occasionally to meet special conditions may be responsible for a number of such cases at some particular time.

The air of firerooms has probably always been of sufficient chemical purity, so far as adequate oxygen and minimal carbon dioxide are concerned, and there is no evidence that carbon monoxide from the furnaces or coal oxidation on the floors has accumulated to produce any such toxic symptoms as are commonly attributed to heat. That this distress tending to heat prostration is a matter of heat and humidity, preventing automatic cooling of the body by evaporation of sweat and by convection to circulating air, as shown last year by Mr. Leonard Hill, of London, was surmised years ago is indicated by the following extracts from sanitary reports:

Surg. George H. Cooke, reporting on the U. S. S. *Mohican*, in 1885, said:

> It was while cruising along the Mexican coast during the rainy season (July and August) and in the warm water and hot murky weather of that region that numerous cases of prostration from heat occurred, as well among the men on deck as with those in the fireroom.

Surg. John C. Wise, on the U. S. S. *Jamestown*, in 1886, said:

> Two deaths occurred during the year—one, a case of insolation, happened when the thermometer stood at 85° F., showing the importance of care in this respect, especially when there is great atmospheric humidity, which so often prevails in the West Indies.

There are probably few medical officers who would now fail to affirm the belief of Chevers, Manson, Castellani, and other eminent authorities, that of the predisposing causes of heat stroke alcohol habituation, or even occasional alcoholism, is one of the greatest factors; and while I personally believe the Navy would be almost infinitely better off if total abstinence could be enforced and the Medical Department and messes of ships quite as well administered if no spirituous, vinous, or malt liquors were permitted on board ship, still, given men who frequently indulge, that there is another side to the practical question is evidenced by the following opinions and practices of former naval surgeons.

Passed Asst. Surg. G. P. Lumsden, reporting on the U. S. S. *Boston*, en route from New York to Jamaica and Central America, October, 1888, says:

> The firemen complained of the heat of the fireroom, which had a temperature of 140° F., and several cases of heat exhaustion occurred; the first on the 6th, the second day out from Sandy Hook. After this 1 ounce of whisky was given each fireman who brought a card from the engineer, at the end of his watch. This seemed to have a beneficial effect, as there were fewer complaints after this, and they appeared to work more cheerfully. At Port Royal 15 gallons of Jamaica rum were purchased by order of the captain, upon the recommendation of the surgeon, which was served out in 1-ounce doses, as stated above, and it lasted until within a few days of New York.

Surg. E. H. Green, on the U. S. S. *Marblehead*, reported, in 1894:

> The temperature of this (berth) deck, with the dynamo running, was from 90° to 92° F., rendering it almost impossible to obtain refreshing rest. The fireroom has had a temperature as high as 140° B. [the author observed it 186° F. July 13, 1906]. Usually it is 120° F., the engine room being from 105° to 110° F. There were several cases of heat exhaustion, though none of them of a serious nature. While cruising in the Tropics it was found necessary to give stimulants at the end of each watch. One and one-half ounces of rum were given, and it had a good effect, as it kept the men up to their work, looking forward to the dram at the end of the watch, and it restored the exhausted system very materially.

Surg. Howard E. Ames's report, on the U. S. S. Detroit, for 1895, says:

> It is here I will make a few remarks upon the engineer's force, based upon observations made upon this vessel, and which, I think, apply to the whole service. The modern warship is a series of small compartments, demanded for strength and security. This compartment system is followed in the coal bunkers. When under steam in hot weather these bunkers are not properly ventilated, and, in addition to this, the heat is too great. The deficiency of fresh air is not so serious a defect as the high temperature which surrounds the men while working. During the summer we were up the Yangtse River, and during that trip the temperature of the coal bunkers ranged from 115° to 127° F., while the outside temperature on deck was from 95° to 100° F. If the engineer's force is expected to maintain its efficiency, it is important that some scheme be devised to overcome this excessive temperature. It is absurd to expect nature to overcome a temperature of 28° F. under such conditions, and no human being can work efficiently in such a temperature without permanent injury to his physical and vital constitution. Take, in addition to the heat, the motionless, impure air of the bunkers, filled with coal dust, constantly clogging the sweat glands of the men, and a moment's thought will picture their deplorable condition. During the trip it was only by giving each fireman and coal passer 2 ounces of whisky at the end of his 4-hour watch that we were able to keep them at work and accomplish the trip. We had several cases of heat prostration, none of which was fatal. The men at the end of the watch were almost collapsed, streaming with perspiration, accompanied by stertorous breathing, rapid pulse, and trembling limbs. The 8 hours' rest was not sufficient to restore them sufficiently to consider them efficient men.

This exhaustion was not due to the work, but to the abnormal conditions surrounding the workers. This is shown by the weight of the coal handled on this trying trip. The general consumption during one day was 26 tons, the daily average for the trip being 18 tons. If we admit that this average was handled twice, it would give us but 36 tons handled in 24 hours by 30 coal passers, or 1.2 tons per day per man, and this work was not continued beyond four hours. Such light physical exertion under normal conditions would scarcely be appreciated in its effect on the physical organization of a healthy laboring man. In this case were are forced to consider the degraded air and the heat as the cause. We can practically eliminate the degraded air of the bunkers by considering the amount of work done under similar conditions but in a temperature below that of the body. We are forced to admit that it is principally due to excessive heat.

Extract from report on the U. S. S. *Bennington*, 1898, by Passed Asst. Surg. E. P. Stone:

The men of the engineer's force, all of whom swing in the wing passages and after berth deck after four hours of severe and arduous toil in the frightful temperature of from 140° to 150°, would come off watch and endeavor unsuccessfully to get rest and sleep in the only comparatively less trying temperature of from 90° to 100°. Unable to sleep, worn out with fatigue, and annoyed by prickly heat, it would be jaded and discouraged men who would respond to the next call to go below on watch. Is it to be wondered at that the medical officer is called upon to furnish stimulants to keep these men up to their duty? Is it to be expected that men in such a condition can do efficient work? And may not a fireroom force in such a plight seriously cripple the fighting efficiency of a ship, as my predecessor has pointed out in his report? It has been the custom on this ship to give, when under way, each watch in the fire and engine rooms some liquor, either during or at the end of the watch. On our way here from San Diego I conformed to the custom after the first few days, principally for its mental effect on the men, as they expected it, and furnishing the liquor served to keep them contented. I have not had enough practical experience yet to feel like making a positive statement, but so far as my experience goes it has inclined me to be opposed to the issue of spirits to men subjected to high temperatures. It produces a temporary stimulation, but leaves the men ultimately in a state of lessened resistance. I believe a better stimulant, and a useful prophylactic, is the administration of strychnia. In those cases of heat prostration that give rise to muscular cramps I believe, theoretically, that subcutaneous injections of normal salt solution ought to give relief.

Extract from report on the U. S. S. *Massachusetts*, 1899, by Surg. S. H. Dickson:

I had been led to expect, under the circumstances of war and during a close blockade and operations in the Tropics of such duration in the summer months, that many cases of heat prostration among the 100 men of the engineer force would be encountered. With fires lit all the time and steam all over the ship; bottled up, so to speak, every night, with temperatures in the firerooms frequently and for hours at a time from 144° to 150° F., in the engine-room rarely below 120° F., conditions were constantly favorable for their development; and yet but 14 cases in all were admitted to the sick list, and these occurred after the removal of the strain and excitement of actual hostilities, and none of them was of a serious character. Careful hygienic measures, such as frequent opportunities for bathing and washing, and the intelligent and constant use of the ventilating blowers, supplying an abundance of fresh air, undoubtedly led to this result. On only one occasion, and for a brief period during the voyage from Porto Rico to Cuba, was it considered necessary to issue a small spirit ration to the engineer division. It put heart into the men and was productive of nothing but good. It was given to each watch on coming off duty and after they had washed and cooled off.

Extract from report on the U. S. S. *Columbia*, 1899, by Surg. C. G. Herndon:

A number of men at various times were more or less overcome by heat in the dynamo, engine, and fire rooms, and were promptly brought to the sick quarters. The heart, and not the brain, was the organ which had given out among these men. The routine practice was to stretch the man out on the cofferdam, with the head low, loosen all tight clothing, and give him a liberal dose of whisky or brandy with digitalis. Usually, in a short time he would go off into a quiet sleep, and wake up ready for work.

I am opposed to the routine issue of alcohol to the men below while on watch, but from my experience, and more particularly on this ship, I believe it would be well, if the bureau sees fit to do so, to increase the amount of whisky in the medical supplies and allow the medical officers to give it to deserving men coming off watch when they show markedly the effects of the long exposure to the high temperature in which they work.

I have seen various stimulants used, but nothing, in my experience and belief, does these men as much good when coming off watch as a ration of whisky diluted with water, and, if necessary, with some digitalis added.

Surg. M. H. Simons, on the U. S. S. *Iowa*, in 1899, reported:

During the trip to San Juan, and on one or two other occasions when the heat was great, the men in the engine and fire rooms drank so much warm water that nausea and vomiting often occurred, and nothing could be retained. We found that under these circumstances the trouble could be checked and even avoided by a moderate dose of alcoholic stimulant (part of the time we used alcohol itself), with capsicum, gentian, or hydrastis. This dose seemed to put the stomach in proper tone for the digestion of food and to lessen the thirst. As a preventive it was given when the men came off watch. Heat prostration was treated by putting the man in a bunk with a wet towel over his face and head and given 0.6 gram of acetanilid; in one hour, if the temperature still stood above 100°, 0.3 gram was given until the temperature stood below 100°, and then a bath was given, in which the patient lay for 15 minutes; the water was at first warm and then gradually cooled to the temperature of the sea water in the pipes, probably about 76°. The acetanilid equalized the circulation and subdued the nervous symptoms: the lukewarm bath seemed to aid this and to exert a specially and noticeably good effect on the digestive tract.

In discussing "The alcohol question in the Navy," Medical Director P. A. Lovering, who was surgeon of the U. S. S. *Oregon* during the Spanish-American War, stated:

I remember that on the cruise of the *Oregon* around from San Francisco, Capt. Clark every day, at his own expense, furnished the firemen coming off the afternoon watch with a drink of spirits. It encouraged the men, did good, and I was very glad that I could recommend it as a beneficial measure.

From our more recent knowledge of the precise nature of the action of alcohol in small doses, it seems evident that the benefits noted in the foregoing reports were psychical, and doubtless attributable to the narcotic effect; alcohol, in these cases, probably induced a more comfortable frame of mind, indicating consideration upon the part of officers in authority, and withal favored relaxation, akin to that sometimes given after disease or injury to relieve undue apprehension. It is significant that no naval reports of the last decade refer to the use of alcohol, either in prophylaxis or treatment.

With reference to the well-known advantage of having ships painted with light-reflecting surface, Medical Inspector T. C. Walton, reporting on the U. S. S. *Chicago* in 1899, says:

> Changing the color of the outside of the ship from black to white is believed to have lowered the temperature on this [gun] deck, during the summer days when the sun shone on the ship's sides, from 4° to 6° F. During the speed trials of this ship at Newport, in Sepetmber last, the temperature in those parts of the engine rooms was recorded as high as 129°. The air at the time was laden with moisture from escaping steam. A prolonged stay there was described as being unbearable. The engineers on duty were quickly prostrated. Efficient ventilation was urged.

Inadequate ventilation and removal of heated air on the earlier all-steam propelled ships is attested by the following quotations:

Medical Inspector G. W. Woods reported, on the U. S. S. *Charleston*, in 1890:

> The heat of the dynamo room is often so great that the thermometers indexed for 140° can not register the temperature, and the men perform their work entirely naked, complaining of nausea and vertigo whenever the revolutions of the little electric blower are even for a brief period suspended.

Surg. T. H. Streets reported on the U. S. S. *Bennington*, in 1893:

> The temperature of the fireroom previous to these changes [new hatch opened and new ventilators] was frequently as high as from 140° to 150°. The temperature has been materially reduced. The highest it has reached since the opening of the hatch is 112°.

On the U. S. S. *New York*, on January 11, 1894, Medical Inspector Edward Kershner found the temperature of living and working spaces to range from 88° to 108° F., throughout the ship, when the outside air registered 82°, although the trade winds blew at the rate of 6 knots on port bow, the ship making 13 knots under but four boilers, and burning but 85 tons of coal per day.

Likewise, in 1894, Surg. W. G. Farwell reported on the U. S. S. *Columbia*:

> The temperature of the engine and fire rooms is excessive when firing hard; the temperature of the fireroom ranges from 140° to 150° F., and that of the engine room from 105° to 110° F.; when firing immediately the temperature

> is respectively from 120° to 125° F. and from 98° to 100° F. The temperature of the cabins opposite [the engine-room hatches] was 90° F., an almost unbearable degree of heat for a sleeping room.

The recording of excessively high temperatures was the rule, rather than the exception, for a few years prior to, and immediately following, the Spanish-American War of 1898.

Surg. C. A. Siegfried reported, on the U. S. S. *Cincinnati*, in 1894:

> In the dynamo rooms, by means of electric (additional) blowers, the temperatures have been reduced 20° F., and they now rarely rise above 110° F. The ventilation of the engine room is very unsatisfactory, and temperatures are recorded from 90° to 170° F. I have myself recorded fireroom temperatures as high as 168° F. In the engine room, lower platform, the average is about 102° F.; on the upper platform it frequently reaches 135° F.

Surg. E. Z. Derr, on the U. S. S. *Raleigh*, in 1894 and 1895, reported:

> The inadequacy of fireroom ventilation made itself manifest on the first trial trip to Hampton Roads: Steaming half power, the temperature of the starboard forward fireroom in the boiler interspace, 5 feet above the floor, reached 180° F. Three men were exhausted by the heat. On September 10, steaming under the same easy conditions, it reached the same, and two men were exhausted. On September 11, 190° F. was recorded. On the fireroom galleries, where the blowers were located, the thermometer registered 205° F., rendering it impossible for the men to superintend them, and accordingly they were not used. The firerooms were therefore dependent upon natural ventilation alone, and that supplied by the ventilation was wholly inadequate to keep down the temperature.

Medical Inspector J. G. Ayres, on the U. S. S. *Olympia*, in 1895, reported temperatures of 180° F. and above in two of the firerooms which had no blowers.

Surg. C. A. Siegfried again, in 1895, on the U. S. S. *Texas*, said:

> It is to me doubtful if any possible system of ventilation in some of these spaces would correct the high temperature ranging from 125° F., in dynamo rooms and redoubt, to 170° F. in hydraulic pump rooms. When the ship is underway the heat becomes excessive, and during the short periods of time when making steam trials last September the number of cases of heat exhaustion treated in one day aggregated 12. The hydraulic rooms furnished most victims; hence the more thorough covering of the hot metals and pipes with nonconducting materials becomes imperative.

The improvement made on the U. S. S. *Cincinnati* in 1895 is shown by the report of Surg. L. B. Baldwin, in which he showed average temperatures of fireroom No. 1 to be 143°, 188°, 187°, 184°, 189°, 191°, and 109° F., with a maximum of 204° F. between June 30 and May 12. After some changes in management of blowers, the average temperature was reduced to 126° and 139° F., with a maximum of 170° F. The average for the year in this fireroom was 145.8° F.

The Surgeon General's report of 1897, covering the year 1896, stated:

> Of the 59 cases of heat stroke, 40 were caused by heat in fire and engine rooms, 7 of the latter being returned from the *Raleigh*, 5 from the *Indiana*, 4 each from the *Amphitrite* and *Massachusetts*, 3 from the *Maine*, *Newark*, and *San Francisco*, and 2 each from the *Cincinnati*, *Alert*, and *Marion*, the remainder, 5, occurring scattered, 1 on each ship.

Surg. Robert Whiting, on the U. S. S. *Monterey* in 1895, reported:

> The continued strain of resisting the high degree of heat early began to tell upon the men of the engineer's force. The closed fireroom of the *Monterey* has no outlet overhead, the doors opening on one side into the overheated engine room and on the other into the berth deck. The forced draft ventilation not being in use, it was discovered that the fireroom was fed by hot air from the engines on one side, and, on the other, by air that had been devitalized by use on the berth deck. The medical officer, upon one of his inspections, found the temperature as high as 147° F. There were quite a number of cases of exhaustion and vomiting, most of which were treated without entry upon the sick list.
>
> The drills at general quarters, which were more frequently performed than any others, required the use of steam in the pump rooms underneath the wardroom officers' quarters and under the berth deck. It will be observed, by reference to the temperature charts, that these pump rooms registered the highest degree of heat, 180° F. It required hours to bring the atmosphere in the wardroom down to 90° F, after these drills were concluded. The dynamo room contiguous to the forward turret, and underneath which the forward pump room is located—the main compartment of the berth deck separated from it by a steel bulkhead—suffered in similar fashion.

Surg. James E. Gardiner's report, on the U. S. S. *Amphitrite*, in 1896, stated:

> So far, the most serious trouble developed has been the one of the high temperature generated on the modern iron and steel ship filled with engines and imperfect means of ventilation so far devised to relieve the evil. From the records of the medical journal the suffering from this cause, while the ship was cruising during the months of July and August, was great. Temperatures as high as 183° F., in the fireroom, are recorded, with 167° F. given as the minimum during the 24 hours of that day. In the engine room, for the same day, are recorded 155° F. as maximum and 148° F. as minimum; the berth deck, 102° F., maximum; a stateroom in wardroom, 98° F. There were numerous cases of heat prostration, cases of myalgia, cramps, and sudden diarrheas. A board appointed by the commanding officer, after carefully collecting the data, made its report, and the ship was ordered to the navy yard at Norfolk, where the changes were made. Since then the conditions have greatly improved. No test as severe, though, as that of last summer's cruising has been made since the change, but it is believed that no such temperatures will again be reached.

Extensive temperature observations, made by Medical Inspector J. G. Ayres, in the dynamo room of the U. S. S. *Olympia* in 1896, gave the maximum as 121° F. and mean as 113° F. for August; and 113° F. and 105° F. for October. In the same year the dynamo room of the U. S. S. *Columbia* was found to have a temperature range from 110° F. to 125° F., and the steam steering room exceeded 120° F., with defective ventilation.

The means for adequately heating certain living spaces in ships often proved intolerable to other compartments, as is shown by Surg. W. S. Dixon's comment on his own stateroom, on the U. S. S. *Brooklyn*, in 1897:

> No less than 75 feet of steam pipe (heating) is very close to the berth—some of it within 2 inches and none of it more distant than 40 inches. Five pipes pass through the room and four are separated from it only by a thin metal bulkhead. Until the five pipes (45 feet) had been additionally covered with felt, one could not sleep in the bunk. With an outside temperature of 19° F., that of this room was 90° F., as determined by reliable thermometers, and the air duct was delivering cold air in the room at the time. In one of the double-berth rooms of the junior officers two thinly covered steam pipes pass along the whole length of the upper berth and in such close proximity that a man of ordinary proportions could scarcely crowd in between the mattress and pipes. It would be impossible for anyone to sleep there while steam was being used to heat the ship.

Surg. W. R. Du Bose reported, from the U. S. S. *Terror*, in 1897:

> Practically, the ship has done no cruising, and exactly what temperatures will be experienced remains to be seen. In the short trips made the engine-room temperature has been 118° F.; the fireroom 116° to 142° F., generally 122° F.; the forward turret machinery space 124° F. In the superstructure, during a heated term in July and August, a temperature of 110° F. was several times noted. No case of heat exhaustion has occurred.

Surg. P. A. Lovering, on the U. S. S. *Oregon*, in 1897, reported:

> The berth deck is also very warm, as it is over the main boilers, and in it is placed the auxiliary fireroom. When the vessel is underway the temperature often rises to 100° F., and even higher, and rarely falls below 85° F. The forward compartment of the citadel is fairly lighted by 12 deck lights, but has no direct air supply. It is much cooler than the central compartments, as it is forward of the boilers.
>
> Each engine room has, besides the usual hatch, a blower for artificial ventilation. The temperature ranges between 90° F. and 100° F. when underway.
>
> Each of the eight firerooms has a large ventilator, and also a blower for forced draft, which is used for ventilation. When underway the temperature has reached 135° F., but is usually 5° to 10° F. lower. This temperature was in cool weather, when the outside air was 60° F. or less, and it is quite probable that in warmer weather the firerooms will be much hotter.
>
> There have been no cases of heat prostration.

The protests of some of our medical officers during this period were almost pathetic, as is seen in the following extract from the report, on the U. S. S. *Bennington*, in 1898, by Surg. John W. Baker:

> We should build our ventilators larger and higher and make them more numerous; provide our firerooms, bunkers, and engine rooms with fans on a large scale, until we no longer are content that men should, in these days of modern science, toil and labor in a vitiated atmosphere at a temperature varying from 130° to 170° F., until they are temporarily exhausted or permanently disabled, and that, too, long before the period assigned to men who live on deck in fresh air and wholesome sunshine, and who are never called

upon to make the physical exertion, save in unusual emergencies, that these men must make every day, if we would maintain our speed at sea, speed and turning in evolutions, in fact the efficiency that is not only desirable but absolutely essential for our success in warfare and for which our ships are constructed.

Surg. M. H. Simons, reporting on the U. S. S. *Iowa*, in 1899, stated:

> The ventilation of the distiller room is entirely inadequate, and the temperature is so high (145° F.) frequently that the man neglects his watch on the gauge to stand under the small cool-air inlet. The exit shafts for hot air in the dynamo room are so small that half the hot air collects in one or the other ammunition passages, increasing greatly the discomforts of those who must work there, especially in battle. The temperature of the dynamo room varies from 107° to 125° F.
>
> The staterooms for the officers in the citadel, at sea in warm weather, have a temperature range of from 93° to 100° F. Artificial light has to be used all the time.

Surg. John M. Steele, on the U. S. S. *Monadnock*, in 1899, reported:

> On entering the tropical zone, where the temperature of the air and water are nearly the same and high, about 84° F., the vessel heated up rapidly and remained so.
>
> The hottest part of the vessel in which men live is the superstructure and warrant officers' quarters. The warrant officers' quarters are next to the dynamo room, and separated by an iron bulkhead, and in the forward room the temperature averages about 95° F. In the superstructure is situated the cabin and wardroom, officers' quarters, also the galley, the officers' water closets, and the mens' head. These apartments are directly over the fire and engine rooms, and the heat here is high and continuous night and day, with an average of about 94° F. There is a slight remission in the early morning hours. In addition to hatches, deck lights, and air ports, the present means of ventilation should apply to the superstructure, and an active method of introducing fresh air, which could be accomplished by two additional blowers. to force air into the entire vessel. This addition would combine the plenum and exhaust which I believe is necessary for the best effect for the health of the crew.

From a better ventilated gunboat, the *Annapolis*, in 1898, Asst. Surg. S. B. Palmer reported:

> No excessively high temperatures have been noted in the engine and firerooms. The two cases of heat exhaustion, of mild grade, which were treated, were men unaccustomed to this work.

Asbestos sheathing helped to alleviate suffering in the living quarters abaft the engine-room trunk of the U. S. S. *New York*, in October, 1899, where the temperature had formerly ranged from 98° to 110° F. Medical Inspector C. U. Gravatt urgently advocated similar insulation in the dynamo room and evaporating room.

All evaporators are nowadays well covered with asbestos, conserving heat for their more economical operation and promoting comfort for their tending.

The surgeon of the "flying squadron," Medical Inspector Paul Fitzsimons, for 1898, stated:

> The fleet blockaded Santiago for five weeks, lying off the entrance about 2 miles in the open sea. Fortunately, the trade winds were usually fresh, and no one suffered from the heat on the main and gun decks. The berth deck was like an oven. It was heated on the outside by the sun and inside by three smokestacks, the battle ports were closed, and a moderate amount of air was driven by the blowers. The warrant officers' rooms were uninhabitable. The awnings could not be spread, and, after a time, the men were permitted to sleep in the open instead of sweltering below. They would lie on the forecastle wrapped in blankets, and no case of sickness was caused by it. The crew also worked in the sun coaling ship frequently without injury.

Since the Spanish-American War, conditions have steadily improved, and the unfavorable reports have come chiefly from the older armored ships, notably the *Monadnock*, *Massachusetts* (in the firerooms of which Surg. J. C. Byrnes reported, in 1900, an occasional temperature of 210° F., reduced 30° F. by changing location of blowers), *Monterey*, *Chicago*, *Iowa*, *Brooklyn*, *Illinois*, *Wisconsin*, *Albany*, *Oregon*, *Alabama*, *Newark*, *Kentucky*, *Colorado*, *Ohio*, and *West Virginia*. Many reports at hand from these 16 vessels, while very interesting, merely reiterate the high temperatures of the living and working quarters.

On the U. S. S. *Texas*, Surg. H. E. Ames reported steering engine-room temperatures of 110° to 115° F., and humidity "so great that there is no evaporation from the body, and those of the crew who are stationed there at sea are exhausted at the end of two hours." The firemen's wash rooms were "from 130° to 145° F." and, of course, the air was saturated with moisture. Fireroom temperature under natural draft was 150° F.

From the U. S. S. *Wisconsin*, in 1906, Medical Inspector H. G. Beyer reported as follows:

> Battleships and monitors will always be the most uncomfortable ships in a climate such as this (Cavite). With perfect sanitary conditions the constant high temperature and humidity from within and without are bound to cause a steady lowering of the average physical and mental strength and endurance of every human being on board. This generally acknowledged fact makes frequent change of station, especially for battleships, not only desirable but imperative.
>
> During the passage of this vessel from Hongkong to Cavite between December 28 and 30, 1905, a series of heat prostrations occurred. Of the 14 cases, 10 were firemen, 2 water tenders, and 2 coal passers. The symptoms varied but slightly in the different cases, and were chiefly those of collapse, with dizziness, headache, and severe cramps in the legs, thighs, arms, forearms, back, and abdomen. In no case was there embarrassment of speech, although loss of voice was noted in one fireman, who stated that this was his second attack. Two of the cases did not show distinct symptoms of heat prostration until some little time after leaving the fireroom, and one of the two was found unconscious.
>
> These patients were at first rubbed with towels soaked in hot water, with excellent results. Some in whom the cramps were painful and distressing

were rubbed with chloroform liniment. Rest, of course, was enjoined upon them, and all were off the list and on duty two days after the arrival of the ship in port.

The direct cause of the outbreak was the heat in the fireroom from what is known as assisted draft. In assisted draft, the fireroom is made as tight as possible, the air inlets and the furnace outlets being the only places in open communication with the fireroom. But, unlike what happens during forced draft, when the blowers have their speed increased, and the incoming volume of air is very much greater than under ordinary draft, in assisted draft the incoming current remains the same, or may even be reduced.

Several points in connection with the occurrence of this interesting series of heat prostrations seem to be unusual. The temperature in the fireroom was not excessive, and alone could scarcely account for so widespread an effect; the relative humidity of the atmosphere was very high, and the temperature and moisture of the atmosphere suddenly increased the day the prostrations occurred. The afternoon we left Hongkong, officers and men wore blue with comfort; the next morning white was ordered, because of the sudden climatic change.

Complaints of high temperatures and humidity on the smaller cruisers and gunboats were made in reports from the *Petrel* (160°), *Isla de Luzon* (172°), *Albany* (136°), and *Princeton* (115°).

On the newly commissioned U. S. S. *Maine*, in 1903, Surg. N. H. Drake recorded 45 cases of heat prostration:

Fifteen admissions to the sick list were allowed for this condition, and about 30 others were treated for vertigo and cramps in the muscles of abdomen and limbs. Only one of those admitted remained on the sick list more than two days, he being under treatment for five days. Many of those not admitted were excused for the whole or a portion of their watch below. This unusual number of cases was attributed to a combination of circumstances, viz: New men unfit for service in their ratings; varying temperatures caused by drafts and blowers; improper clothing of the men in the fireroom; the use of too much cold water while on watch; drinking water unfit for use on account of chlorides, and extremely hard work in a climate to which many of them were unaccustomed.

Asst. Surg. A. G. Grunwell, who later evolved the interesting theory that heat cramps might be occasioned by absorption of toxins of tetanus bacilli from intestinal contents, in 1900 treated heat stroke successfully by venesection in the walled city of Tientsin during the Boxer uprising.

The following extracts from the annual report of 1909 of the Surgeon General of the Navy, show how recently heat affections seemed to deserve special attention:

Heat exhaustion is less prevalent than it was two and three years ago for the reason that the small cruisers with poorly ventilated firerooms have either been withdrawn from tropical service or placed out of commission. The opinion that heavy muscular work has been a contributory essential, and that heat, humidity, and rapid cooling of the body are not the only causes, receives some support from an observation of Passed Asst. Surg. G. H. Hathaway, on the U. S. S. *Cheyenne*, which now burns oil fuel; this officer shows that during the standardization runs at maximum speed, the temperature in the fireroom rose to 140°, which is about 10° higher than under previous similar conditions when burning coal. Nevertheless, in this higher temperature no case of heat prostration occurred, nor during the cruise has any member of the engineer's force succumbed to the heat. It is thought that the slight amount of physical exertion required to regulate the burners, as compared to passing coal, enables the fireroom watch to withstand a greater elevation of temperature. While cruising, the number of men on duty in the fireroom is reduced to about one-half those required for coal fuel, which is of some sanitary advantage. * * * Just what factors enter into the causation of the condition known as heat prostration observed in those exposed to excessive heat, either solar or artificial, particularly fireroom, is not definitely known to-day. There have been a great many cases in the Navy during past years, and though, in 1908, a fewer number than usual were reported, and although effort has been made, and is being made, to improve the condition under which the engineer's force performs its duties, there seems no immediate prospect that the condition will cease to be an important type of disability.

Although not occurring on shipboard, it would be amiss not to include in these extensive quotations the cases mentioned in an extract from the report of Surg. G. A. Lung, on duty with the First Regiment of Marines, in the Peking Relief Expedition of 1900:

Two types of heat stroke were observed. The more common one was exhibited with extreme fatigue, mental depression, weak circulation, with perhaps partial loss of consciousness. The other appeared more suddenly and was marked by hard, fast pulse, suffused face, bloodshot eyes, complete unconsciousness, and perhaps delirium, with muscular spasms of the entire body. These cases would appear while the column was moving, or immediately on coming to a rest. If on the march, they would stumble and fall in the roadway, or, while sitting, would suddenly topple over. The first intimation the medical officer would have would be the cry with stentorian insistence for the doctor, and on some days it came with startling frequency. They were carried to one side, an imperfect shelter from the sun for the head made by bending several standing cornstalks together, and the best remedies at hand applied. If the patient appeared seriously ill, a man was left with him, or several thus affected would be gathered together and one man look after all. In the meantime the column would move on, leaving them behind. The number who had convulsions was comparatively small. A large percentage became unconscious.

August 10th was a peculiarly trying day because of the heat. By noon, fully 75 of the regiment had dropped out. It is true some of these were only very badly wearied, and found an example in those who were more than wearied. There was, however, no shirking or malingering. Every man seemed to realize the character of the expedition and the purpose for which it was made. Indeed it was sometimes touching to see a man with a determined expression, trudging along, staggering from weakness and the weight of his accouterments, and with a degree of illness that entitled him to a bed in a hospital. A few of the men, instead of dropping out at once, would gradually drop to the rear where they would totter along, crying like a lost child, until relieved of their burden by a companion, or forced to lie down and rest.

A most remarkable feature of these cases of heat stroke was the rapidity with which they recovered. Often, without any treatment whatever, and by night, all, by helping one another or by getting a lift in a wagon or a ride on a horse, would overtake the column encamped for the night. The following day they would take their places in the ranks again. If the expedition happened to be near the river, and junks were available, the worst cases were sent on them for a day's rest.

There were but two deaths from this cause, one occurring at the battle of Yangtsung and the other at Tungchow. Two were afflicted with mild melancholia, but after a short rest in the hospital they recovered.

Undoubtedly the most complete reports on heat cramps by medical officers of the Navy in recent years are those of Surg. M. S. Elliott in the Military Surgeon for March, 1908, and of Surg. A. G. Grunwell in the United States Naval Medical Bulletin for July, 1909. Their clinical notes are too extensive to be quoted here, and from the one autopsy by Elliott the only characteristic pathological condition found was congestion of kidneys.

Sunstroke, as typically occurring in the midsummer heat of our cities, is now comparatively rare in the Navy, the last published case being one observed by me off Acajutla, Salvador, in 1907, in the person of a boat keeper of the U. S. S. *Marblehead*, who fell asleep and became unconscious in his boat without awning cover and experienced total amnesia for 69 hours. Thermic fever does not appear to have been a very important factor since the Spanish-American War, when 89 cases were recorded. During the 25 years from 1886 to 1910, inclusive, there were returned 1,507 heat cases, of which 64 per cent were heat prostration (commonly of the exhaustion type), 32 per cent were classified as thermic fever, and 4 per cent as insolation. About one-third of the cases of thermic fever developed on shore, and doubtless a good part of the few on board ship were ill-defined confusion cases.

So far as I can learn, heat stroke between decks among men not performing hard work is unknown in our Navy. If it were now common for persons to be stricken in cabins while asleep, we should certainly look for the condition among our 10,000 man-o-war'smen here about Key West and Cuba during this midsummer.

From the recorded and personally received opinions of naval medical officers I feel justified in affirming that the characteristic heat affection of the naval personnel has during the past quarter century been "prostratio thermica" heat exhaustion, largely confined to the fireroom force. During 1909 and 1910, respectively, the admission rates per thousand for heat affection in the fireroom force were 8.45 and 7.91, respectively, while for the entire service they were 2.79 and 2.16, respectively, every other occupational group having ratios below the mean with the exception of the engineer's force, which were 3.26 and 2.78 for the respective years. This most common form, heat exhaustion, is believed to be a disease entity with either the systemic or muscular symptoms predominating, the one form sometimes predominating almost to the exclusion of the other. The heat regulation centers do not appear to be so profoundly incapacitated as in sunstroke, there being but slight fever or very commonly the subnormal temperature of shock. Marine Oberassistenzarzt, Dr. Esch, however, considers his case chiefly one of deranged nerve centers.

There is pallor or lividity, drenching perspiration, weakness of both voluntary and involuntary muscle, the circulatory and respiratory functions being profoundly embarrassed. Sensory motor phenomena are those of exhaustion rather than of the irritable, responsive to the least stimulation, type; there is the tendency to sleep and stupor rather than to convulsions. Now, although paradoxical, it is no inconsistency that the other notable symptoms may become prominent, such as fibrillary twitchings and violent painful cramps of muscles of abdomen, arms, and legs. These can hardly be due to any systemic nerve poison, but must be consequent upon a local dehydration of muscle tissue with a diminished alkalinity of plasma from excessive production and retention of katabolic acids (sarcolactic, carbonic, and lactic) which have been shown by McDougall and E. B. Meigs to attend muscle rigor. The accumulation of products of tissue metabolism generally may account for vaso-motor paresis and shock. It is, of course, important to distinguish cases of intestinal cramps due to dietetic error or ice water ingestion from the heat cramps of abdominal wall muscles.

The etiology and incipiency of heat exhaustion need not be at variance with those of sunstroke except in intensity; the assumption is tenable that in sunstroke the factors are so fulminating and of such an overwhelming character that heat production and loss are promptly deranged, whereas the symptoms of heat exhaustion represent the sustaining and finally failing efforts upon the part of the human body to overcome its adverse environment. I shall be content to enumerate these factors in causation of heat exhaustion, no one of which has been certainly eliminated as either contributory or immediate; no special combination seems to be essentially determining: Chronic alcoholism with fatty infiltration of the heart,—dilation, when called upon to pump more blood through lungs and skin under stimulation of excessive heat; dissipation or debility from disease or unsuitable hygiene, such as overcrowding; hard muscular work (Edsall), and unrelieved fatigue; insufficient circulation of air and wet-bulb temperature from 85° to 95° (J. S. Haldane's critical point, and Harvey Sutton's vicious circle); lack of habituation; constricting or heavy clothing; fright or panic induced by occurrence of other cases, as shown by Oswald Rees, R. N.; loss of sleep (H. M. Welch); improper nutritive ratio; excess of protein and deficiency of carbohydrates; insufficient assimilation of water; to these may be added Senftlenben's observation of blood concentration, red corpuscle destruction, and hæmoglobinemia more commonly expected in sunstroke: arterial anemia, toxin and fibrin ferment accumulation from preponderance of skin over kidney excretion, and leucocyte destruction (Maurice de Fleury); predisposition by former attacks (W. H. Cameron and Logan Clendening). The actinic theory of Lieut. Col. R. J. S. Simpson is mentioned merely to be excluded from our cases among the fireroom force.

For the physiologist, no doubt, the inclusion of so many causative factors, direct or remote, is very unsatisfactory, confusing, and a confession of ignorance, but, for the hygienist, their probable relation has given such hints that the removal of few or many has contributed to the great decline in heat exhaustion and cramps in the Navy. If I were called upon to single out any one remdy to bring about this result more than another, it would be the increased circulation of air where the men work, rather than any mere lowering of temperature or humidity.

Statistical table of heat affections in the United States Navy and Marine Corps, 1861–1911.

Year.	Mean strength (medical returns).	Cases.	To hospital.	Invalided from service.	Deaths.	Sick days.	Total damage in percentage of sick.
1861	20,000	5	....	....	....	(2)	(2)
1862	25,905	34	....	....	....		
1863	40,000	16	....	....	....		
1864	43,787	27	....	....	....		
1865	32,641	3	....	....	1		
1866	17,193	(1)	(1)	(1)	(1)		
1872	11,570	....	....	....	....		
1873	12,723	14	....	....	....		
1874	13,870	19	....	....	....		
1875	10,141	5	....	....	1		
1876	11,138	8	....	....	....		
1877	7,461	[3] 17	....	....	....	....	....
1878	7,806	10	....	....	....	26	0.000791
1879	8,869	(4)	....	....	....	....	....
1880	9,003	23	....	5	....	89	.026668
1881	9,546	18	3	1	....	50	.005729
1882	9,371	12	1	....	....	61	.001576
1883	9,197	10	1	1	....	166	.009670
1884	9,959	18	....	....	....	72	.001797
1885	9,191	[5] 20	1	....	....	103	.003070
1886	9,188	5	....	....	1	20	.005442
1887	9,618	41	1	....	....	226	.006438
1888	9,955	25	....	....	1	96	.007657
1889	11,219	33	3	....	....	216	.005275
1890	11,768	37	....	....	....	257	.005983
1891	11,501	41	3	....	....	195	.004645
1892	11,775	29	2	....	1	135	.007760
1893	12,109	51	1	1	....	293	.010758
1894	12,520	44	....	....	2	190	.012145
1895	12,671	92	....	....	1	359	.011562
1896	13,768	59	3	....	1	257	.008622
1897	15,229	81	4	....	1	339	.010356
1898	23,038	512	19	7	....	2,054	.039019
1899	20,113	154	10	1	1	939	.017594
1900	22,977	128	13	....	5	442	.015798
1901	26,101	95	4	2	1	645	.012352
1902	30,249	95	5	1	1	503	.007757
1903	36,535	94	2	1	2	333	.006543
1904	39,450	92	13	....	....	569	.003941
1905	39,620	160	3	....	....	655	.004529
1906	41,690	168	15	3	1	739	.009559
1907	44,083	86	4	4	....	504	.007448
1908	50,984	106	17	1	....	801	.005220
1909	55,550	155	6	3	....	703	.006090
1910	56,721	125	....	1	....	391	.002755
1911	61,399	88	....	1	1	423	.003516

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[1] No data available in published reports from 1866 to 1872.

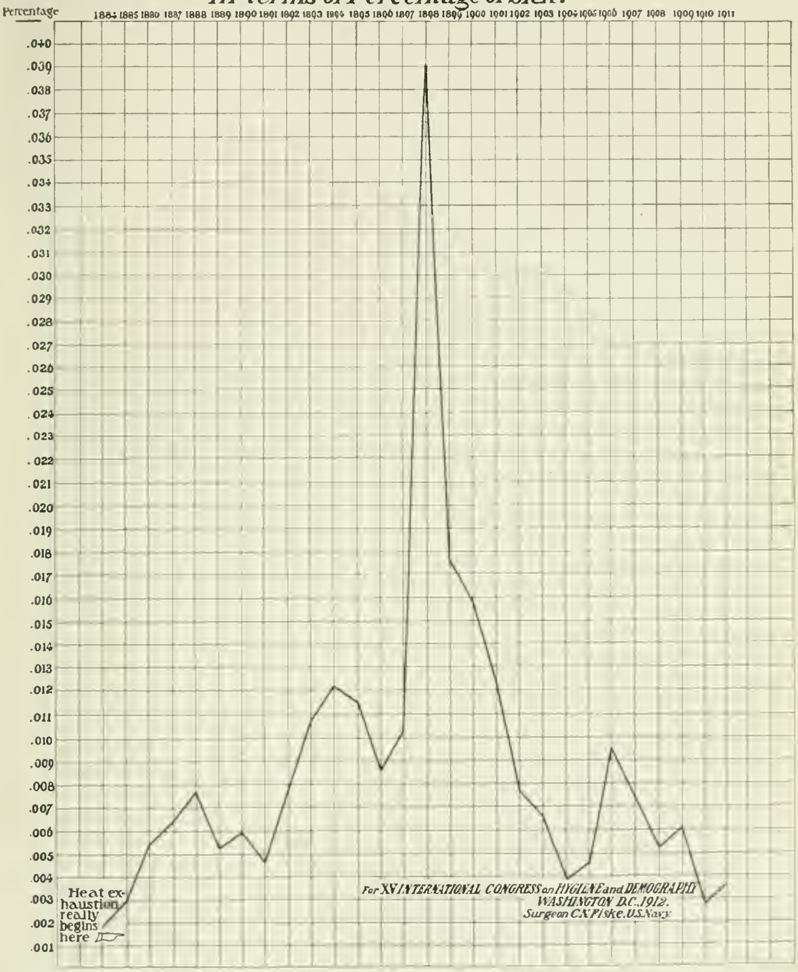
[2] Apparently all insolation.

[3] "Heat exhaustion" (2 cases) first mentioned on Asiatic Station.

[4] Not mentioned in reports.

[5] "Heat exhaustion" really begins.

Curve of Total Damage from Heat Affections in U.S. Navy and Marine Corps in terms of Percentage of Sick.



For XV INTERNATIONAL CONGRESS on HYGIENE and DEMOGRAPHY
WASHINGTON D.C., 1912.
Surgeon C. N. Fiske, U.S. Navy.

ÜBER DIE UNGLÜCKSFÄLLE UND BERUFSKRANKHEITEN DER MINEN- UND TUNNELARBEITER.

San.-Rat Dr. Wilhelm Lindemann, Oberarzt des Allgemeinen Knappschafts-Vereins in Bochum, Deutschland.

Leitsätze.

1. Durch die Fortschritte der bergbaulichen Technik haben die tötlichen Verletzungen eine Abnahme erfahren.

Die Verletzungen überhaupt zeigen eine Zunahme, die jedoch geringer ist, als die Zahlen der Statistik angeben, und die an erster Stelle bedingt wird durch eine schnelle Entwickelung des Bergbaues und die dadurch bedingte Einstellung ungeschulter Arter.

Die Unfallgefahr im Bergbau erfordert auf jedem Bergwerk Vorkehrungen für die erste Hülfeleistung und Bildung von Rettungscentralen und Rettungswehren.

2. Das Emphysem verdankt an erster Stelle der anstrengenden Arbeit im Bergbau seine Entstehung. Fortschritte der bergbaulichen Technik vermindern diese Krankheit.

3. Die Anthrakosis pulmonum ist eine Inhalationskrankheit. Schwere Erkrankungsfälle werden verhütet durch Anwendung des Berieselungsverfahrens im Bergbau, durch Vermeidung der Kinderarbeit und durch wohlwollende Invalidisierung der Arbeiter.

4. Der Kohlenstaub verhindert weder die Entwickelung der Tuberkulose noch des Carcinoms; er begünstigt nicht die Entstehung akuter Lungenerkrankungen.

5. Die Zahl der rheumatischen Erkrankungen wird weit überschätzt.

6. Der Nystagmus der Bergleute ist eine Folge von Überanstrengung und Blendung der Augen bei der bergmännischen Arbeit; er verhindert nicht, an der Benzin-Sicherheitslampe die zuverlässige Wahrnehmung eines Schlagwettergehaltes der Grubenluft von 2–3 Prozent.

7. Eine spezifische Blutarmut der Bergleute besteht nicht.

8. Zur Verhütung der Anchylostomiasis bleibt die Beschaffung transportabler Abortkübel die wichtigste hygienische Massnahme. Die mikroskopische Kotuntersuchung wird in ihrer Zuverlässigkeit überschätzt.

M. H. Wenn ich der Aufforderung unseres Herrn Präsidenten, Ihnen heute ein kurzes Referat über die Unglücksfälle und Berufskrankheiten der Minen- und Tunnelarbeiter zu erstatten, gerne entspreche, so bin ich mir wohl bewusst, dass die erdrückende Fülle des Stoffes einen Verzicht auf Vollständigkeit gebietet, und dass die weitgehenden Verschiedenheiten der örtlichen Verhältnisse ein zusammenfassendes Urteil erschweren, gleichwohl gebe ich mich der Hoffnung hin, dass meine Ausführungen, die sich stützen auf die Erfahrungen des Allgemeinen Knappschafts-Vereins Bochum, des grössen deutschen Knappschafts-Vereins, der die 350.000 Bergleute des Rhein.-Westf. Kohlenbergbaues umfasst, in dem einen oder dem anderen Punkte nicht ohne Interesse sein mögen. Auch bei dieser Beschränkung gestattet die mir zugemessene kurze Zeit nur einige wichtige Punkte heraus zu greifen, und ich muss um Ihre Nachsicht bitten wenn ich um wenige Minuten die mir zugemessene Zeit überschreiten sollte.

Die dem Bergbau eigentümlichen Grubenkatastrophen durch Schlagwetter und Brandwetter sind es vor allem, die das allgemeine Interesse wachrufen. Auch in den letzten Jahren haben derartige Katastrophen den Bergbau vielfach heimgesucht. Ich nenne nur die Namen Courrières und Radbod. Ich verweise ferner—um nur die grössten Unglücksfälle hervorzuheben—auf die Katastrophe in der Steinkohlengrube der Lackawanna Coal and Coke Co. Wehrunin (Pensilvanien), auf den Grubenbrand der Zeche Borussia in Westfalen, ich erinnere an das Schicksal der St. Paul-Grube in Cherry in Illinois, an die Katastrophen in Primero (Colorado) und Drakesburg in Kentucky, an die Katastrophe der Palosmine in Alabama, an die Massenunglücke in den Minen von Whitehaven und Knoxville, an den Grubenbrand der Schwefelgrube Caltanisetta in Sizilien und an die schweren Explosionen in MacKurtin (Oklahoma), in Bluefields (West Virginia). In aller Gedächtnis sind noch die Katastrophen auf der Insel Yesso in der Grube der Hokkaido-Gesellschaft und in Cadeby in England, das schwere Grubenunglück der westfalischen Steinkohlengrube "Lothringen" und der französischen Grube Clarence, die nur wenige Wochen hinter uns liegen.

Die Wucht dieser Unglucksfälle leitet das öffentliche Urteil in doppelter Hinsicht irre. Der Bergbau ist nicht, wie vielfach angenommen wird, der gefährlichste gewerbliche Beruf, es sind anderseits auch nicht die Grubenkatastrophen, die im Bergbau die meisten Opfer erfordern. Nach sicheren Zahlen der Statistik steht von den gewerblichen Berufsgenossenschaften Deutschlands die Knappschafts-Berufsgenossenschaft, welche den gesamten Bergbau Deutschlands umfasst, hinsichtlich der Unfallgefahr erst an siebster Stelle, indem im Jahre 1909 15.38 und im Jahre 1910 14.67 entschädigungspflichtige Unfälle auf 1,000 Vollarbeiter kommen, und im Rhein.-Westf. Bergbau, ebenso auch im ganzen preussischen Steinkohlenbergbau entfallen nur etwa 10–13 Prozent der tötlichen Verunglückungen auf Explosionen, während auf den Stein- und Kohlenfall etwa 38–40 Prozent und ein etwa gleicher Prozentsatz auf die Unfälle in Schächten und Strecken entfallen.

In Bezug auf die tötlichen Verunglückungen im Bergbau ist in Deutschland der Rhein.-Westf. Bergbau mit einem jährlichen Verluste von etwa 2.25 auf 1,000 Arbeiter am schwersten belastet. Nur das Jahr 1908 zeigt infolge des Massenunglücks auf Zeche Radbod noch ein Emporschnellen der tötlichen Verletzungen auf 3 p. m., aber auch dieses Unglücksjahr erreicht nicht mehr die Höhe, die noch vor einem Menschenalter bestand. Im Jahre 1879 betrugen noch die tötlichen Verletzungen ohne Massenunglücke 3.18 auf 1,000. Noch deutlicher wird der Rückgang der tötlichen Unfälle, wenn man sie im Verhältnis setzt zu der gewonnen Kohle. Die gesamte Produktion des Rhein.-Westf. Bergbaues im Jahre 1879 mit rund 20 Millionen Tonnen Kohlen forderte 253 Todesopfer; die vierfache Produktion des Jahres 1907 mit 80 Millionen Tonnen Kohlen brachte etwa die doppelte Zahl tötlicher Verunglückungen (536). Nur in dem Unglücksjahre 1908 mit der Katastrophe auf Radbod stieg bei einer Förderung von 82 Millionen Tonnen Kohlen die Zahl der tötlichen Verunglückungen auf 1,025, während im Jahre 1909 bei gleicher Produktionshöhe die Zahl der tötlichen Verunglückungen auf 889 wieder sank, das Jahr 1910 mit 86.8 Millionen Tonnen 778 Todesopfer forderte und 1911 bei einer Produktion von 91 Millionen Tonnen 819 Bergleute tötlich verunglückten. Die Fortschritte der bergbaulichen Technik sind es denen wir diesen Rückgang der tötlichen Verunglückungen verdanken.

Es kann hier nicht meine Aufgabe sein, und es würde auch die Grenzen meines Wissens weit überschreiten, auf diese Fortschritte im einzelnen einzugehen. Ich will nur daren erinnern, dass das Abbauverfahren durch Berge- und Spül- oder Schlammversatz, dass dem Lande entstammt, dessen Gastfreundschaft wir heute geniessen, in dem kurzen Zeitraum von 10 bis 12 Jahren sich in dem gesamten deutschen Kohlenbergbau eingebürgert hat und immer mehr den mit seinen Ventilationsschwierigkeiten und zahlreichen Explosionsunfällen behafteten Pfeilerbau verdrängt,[1] die gefürchteten Schlagwetterreservoir, die durch die alten verlassenen Baue gebildet wurden, beseitigt eine zuverlässige Wetterführung erleichtert und die Gefahr des Stein und Kohlenfalles vermindert. Es sei ferner noch hingewiesen auf die Einführung des systematischen Ausbaues bei der Verzimmerung der Abbaue, ein Resultat der preussischen Stein- und Kohlenfall-Kommission, die im Jahre 1906 dieser Gefahrenquelle ein intensives Studium widmete, das dem in- und ausländischen Kohlenbergbau in der Praxis wertvolle Verbesserungen gebracht hat. Auf den fiskalischen Gruben Preussens an der Saar ist die Zahl der Unfälle durch diese Gefahr infolge allgemeiner Einführung dieses Verfahrens in den letzten Jahren um etwa 50 Prozent zurückgegangen, und im Auslande bediente sich als eine der ersten die Grube Courrières vor ihrer schweren Katastrophe dieses Verfahrens mit gutem Erfolge.[2]

Die Beschränkung des Gebrauches von Schwarzpulver und Dynamit bei der Sprengarbeit auf wetterfreie Gruben, die sorgfältige Prüfung der sogenannten Sicherheitssprengstoffe auf ihre Explosionssicherheit, bevor sie zum Gebrauch in Schlagwettergruben zugelessen werden, Ladung und Schuss bei der Sprengung ausschliesslich durch erfahrene und zuverlässige Leute, sogenannte Schiessmeister, sind weitere wichtige Massregeln.

Die Grosse Gefahr, welche dem Kohlenstaub als solchem in Bezug auf Explosionsfähigkeit inne wohnt, die erst in den letzten 15 Jahren in ihrem ganzen Umfange erkannt wurde, findet ihre wirksamste Bekämpfung durch eine intensive Berieselung mit Wasser aller staubgefährlichen Betriebe, ein Verfahren, mit dessen obligatorischer Einführung die preussische Behörde allen anderen Kohlenländern vorausgegangen ist, und in dem wohl die Zukunft noch mancherlei Wandel und Besserung bringen wird. Ich erinnere hier an das von Meissner angegebene Stosstränkverfahren, dem als Vorsüge nachgerühmt werden Entgasung und Lockerung der Kohle, staubfreie und ergiebige Gewinnung und Verminderung der Sprengarbeit.

Mit dem erfreulichen Rückgang der tötlichen Verunglückungen steht in einem gewissen Widerspruche eine stete Zunahme der Unfälle überhaupt seit dem Erlass des Unfall-Vers.-Ges. im Jahre 1885. Im Oberbergamtsbezirk Dortmund, der den gesamten Rhein.-Westf. Bergbau in sich schliesst, wurden Betriebsunfälle angemeldet im Jahre 1885–86, 7,885; auf 1,000 Arbeiter, 75.88; auf den Arbeitstag, 26.28. In steter Zunahme erreichte im Jahre 1910 die Zahl der angemeldeten Unfälle 53,654; auf 1,000 Arbeiter, 155.67; auf den Arbeitstag, 178.85. Aus den Berichten der Berufsgenossenchaft ist auch ersichtlich, dass vorwiegend eine Zunahme erfahren haben die Unfälle, welche durch Fahrzeuge, Beförderung von Lasten und Gebrauch von einfachen Handwerkszeugen veranlasst sind, während bei der eigentlichen bergmännischen Arbeit, Schiessarbeit ect. die Zahlen keine Verschlechterung aufweisen.

Es ist zweifellos, dass eine scheinbare Zunahme der Unfälle seit dem Erlass des Unfall-Vers.-Ges. dadurch bedingt ist, dass unwesentliche Verletzungen, leichte Quetschungen und Verstauchungen, welche früher unbeachtet blieben, nunmehr zur Anmeldung gelangten, und dass nicht selten Gesundheitsstörungen, die mit einen Unfalle tatsächlich in einem ursächlichen Zusammenhange nicht stehen, und zum Teil den Charakter der Berufskrankheiten haben, wie Lumbago, rheumatische Schmerzen der Gelenke und Muskeln, zahlreiche Hernien, Lungen- und Magenblutungen, Betriebsunfällen zur Last gelegt werden. Wenn man diese Zahlen auch nicht gering bewerten will, so bleibt es doch ausser Zweifel, dass neben dieser scheinbaren Zunahme der Unfälle auch eine tatsächliche Zunahme der Unfälle besteht, für die an erster Stelle der Umstand verantwortlich zu machen ist, dass der schnelle Aufschwung des Bergbaues die Einstellung vieler ungeschulter Arbeiter erforderte. Für diese Annahme spricht schon der Umstand, dass die staatlichen Bergwerke an der Saar in ihrem ruhigen Betriebe mit vorwiegend einheimischen Arbeitern im Jahre 1910 nur eine tötliche Unfallziffer von 0.9 auf 1.000 gegenüber den 2,245 auf 1,000 des Rhein.-Westf. Bezirks aufweist. Als direkt beweisend betrachten wir die Tatsache, dass im Rhein.-Westf. Bezirk die nicht einheimischen Arbeiter eine viel grössere Unfallziffer aufweisen, als die einheimischen Bergleute.

Unter den Arbeitern des Rhein.-Westf. Bezirks befinden sich etwa 40 Prozent Ausländer und aus dem Osten des Reiches eingewanderte, meist polnisch sprechende Arbeiter. Es wurden verletzt im Jahre 1910 auf 1,000: Ausländer, 217; Reichsangehörige aus dem Osten, 172; einheimische Arbeiter, 165.

Der moderne Bergbau mit seinen zahlreichen maschinellen Einrichtungen stellt grosse Anforderungen an die geistige und moralische Qualität der Arbeiter, er fordert grosse Zuverlässigkeit, Aufmerksamkeit, Umsicht und Besonnenheit. Unzureichende Kenntnis der bergmännischen Gefahren, geringere Intelligenz und Aufmerksamkeit, unzureichende Sprachkenntnis müssen dazu führen, dass Gefahren und Vorschriften im Betriebe unzureichend gewürdigt und beachtet werden. Ob noch nebenher in gleicher Richtung wirkend ein grösserer gewohnheitsmässiger Alkoholgenuss der verschiedenen Arbeiterkategorieen mit seiner die Merkfähigkeit und Besonnenheit einschränkenden Wirkung in Betracht kommt, ist eine Frage, die noch weiterer Prüfung bedarf.

Ist unsere Auffassung richtig, so muss ein ähnliches Verhalten der Unfallziffern in all denjenigen Bezirken nachweisbar sein, in denen wie in Westfalen infolge des raschen Aufschwunges des Bergbaues die Heranziehung zahlreicher ungeübter Arbeiter notwendig wurde. Günstiger dagegen werden die Verhältnisse liegen in bergbaulichen Betrieben mit ruhiger Entwickelung und beruflich geschulten Arbeitern. Zutreffende Vergleiche werden aber sehr erschwert durch die grosse Verschiedenheit der Verhältnisse in selbst räumlich benachbarten Gebieten. Vielleicht erklärt sich aus diesem Umstande zum Teil die Tatsache, dass die Zahl der Explosionen in Belgien trotz des hohen Gasgehalts der Kohle viel geringer ist als im Rhein.-Westf. Bezirk—gleich sorgfältige Zählung vorausegesetzt. Im Jahre 1906 und 1907 ereigneten sich im Belgischen Bergbau keine Explosionen, während im Jahre 1906. 21; im Jahre 1907, 20 Explosionen im Rhein.-Westf. Bezirk gezählt wurden.

Die Ansicht, dass fortschreitende Ermüdung die wichtigste Quelle der Betriebsunfälle bilde. findet keine Stütze bei der Zusammenstellung der Unfälle nach der Zeit ihres Eintrittes weder in Bezug auf die Tage der Woche. noch bezüglich der Schichten und Ueberschichten. Sie steht auch in Widerspruch mit der grossen Unfallziffer des Rhein.-Westf. Bergbaues gegenüber den anderen Bergbaurevieren Deutschlands, wenn man berücksichtigt, dass der Rhein.-Westf. Bergbau mit seiner achtstündigen Schichtdauer die relativ kürzeste Arbeitszeit besitzt: wir neigen aber zu der Auffassung, dass Hast und Eile bei der Arbeit einen mitbestimmenden Einfluss auf die Häufigkeit der Unfälle haben.

Absichtliche Unfallbeschädigungen zwecks Erlangung einer Unfallrente sind gewiss selten; häufiger werden angebliche Unfälle und schon früher vorhandene Beschädigungen vorgeführt, um eine Rente zu erlangen. Dass das Unfall-Vers.-Ges. durch das Bewusstsein, gegen Unfall versichert zu sein, Achtsamkeit und Vorsicht der Arbeiter mindert, ist eine Möglichkeit, über deren praktische Tragweite nähere Ermittelungen fehlen. Ausser Zweifel ist es jedoch, dass mit dem Unfall-Vers.-Ges. die sogenannte traumatische Neurose ihren Einzug gehalten hat und zahlreiche Verletzungen kompliziert. Dass es sich bei der grossen Verbreitung dieser Störung lediglich um eine Folge des Unfall-Vers.-Ges. handelt, beweist schon die Tatsache, dass vor dem Erlass des Gesetzes bei den gleich schweren Verletzungen des Bergbaues und unter noch ungünstigeren wirtschaftlichen Verhältnissen dieses psychisch-nervöse Krankheitsbild kaum in Erscheinung trat. Es darf auch wohl daran erinnert werden, dass Bianchi-Neapel[3] nach dem furchtbaren Erdbeben von Messina und Reggio bei seinen zahlreichen Untersuchungen keinen einzigen Fall der traumatischen Neurose ermitteln konnte, eine Beobachtung, der gegenüber die Ansicht, dass Schockwirkung und Alteration des Gefässsystems die Grundlage aller traumatischen Neurosen bilden[4] unhaltbar sein dürfte. Selbstverständlich dürfen bei der Diagnose die traumatische Neurose und Rentenhysterie nicht verwechselt werden mit Schreckpsychosen und mit den nervösen Störungen, welche nach Schädelbrüchen, Hirnquetschung und Kohlenoxydvergiftungen auftreten können.

Die erfolgreiche Bekämpfung dieser unerwarteten und unerwünschten Wirkung des Unfall-Vers.-Ges. liegt daher auch nicht allein, und nicht an erster Stelle in den Händen des Arztes.

Die grosse Unfallgefahr im Bergbau erfordert eine ausreichende Bereitstellung der ersten Hülfe und eine sorgfältige Organisation des Rettungswesens. Zu der ersten gehören ein vollständig eingerichtetes Verbandzimmer auf jeder Mine. Krankenbahren unter Tage, Krankentransportwagen über Tage und zur ersten Hülfeleistung befähigte und jederzeit disponible Kräfte. Die Verbandszimmer unter Tage zu verlegen hat keine Vorzüge, denn dadurch wird die ärztliche Hülfe erschwert und es besteht die Gefahr, dass bei grösseren Katastrophen die Einrichtungen unbrauchbar werden. Die Erfahrung hat gelehrt, dass Atmungsapparate, die einen Aufenthalt in Nachschwaden und Brandwetter gestatten, sowie Sauerstoffapparate zur Wiederbelebung in schweren Fällen Rettung bringend sich bewähren können. Die Erkenntnis, dass ein wirksamer Gebrauch der Atmungsapparate, sowie der Erfolg von Rettungsarbeiten überhaupt. eine gut ausgebildete und in steter Übung erhaltene Truppe kräftigen und gesunder Männer voraussetzt, hat schon seit vielen Jahren auf den grossen Gruben des Rhein.-Westf. Bezirks zur Bildung von Rettungswehren geführt, die jederzeit zum Eingreifen bereit und mit allen erforderlichen Apparaten ausgerüstet sind. Ich erinnere an die Hülfleistung der deutschen Rettungswehren bei der Grubenkatastrophe in Courrières. Da aber nicht allein eine ständige Übung der Rettungsmannschaften, sondern auch mit Rücksicht auf die Unsicherheit und Kompliziertheit der Rettungsapparate stets eine sorgfältige Kontrolle dieser notwendig ist, können die kleineren Gruben des gleichen Vorzuges nur teilhaftig werden, wenn sie an eine Rettungscentrale Anschluss finden. Diese Erwägung führte im Jahre 1910 zur Bildung einer ausgedehnten Rettungscentrale in Rhein.-Westf. Bezirk, an die 219 Schachtanlagen angeschlossen sind, die gegenwärtig über 4,036 ausgebildete Hülfsmannschaften und 1,918 Rettungsapparate und Sauerstoffkoffer verfügt. Es ist damit eine Organisation geschaffen, die trotz ihrer kurzen Existenz schon erfreuliche Resultate aufweisen kann und zu weiterer Ausbildung und Nachbildung ermutigt.

Wenden wir uns zu den Berufskrankheiten der Bergleute und Tunnelarbeiter, so muss hervorgehoben werden, dass die weit verbreitete Ansicht, dass die Bergleute vorwiegend von Erkrankungen der Atmungsorgane heimgesucht werden, in den Erfahrungen des A. K. V. keine Bestätigung findet. Überragten doch die Erkrankungen der Verdauungsorgane der Zahl nach die Erkrankungen der Atmungsorgane jährlich um 6 bis 7,000 Krankheitsfälle; aber die Erkrankungen der Verdauungsorgane sind unabhängig von den Schädlichkeiten des Berufs, während die wichtigsten Erkrankungen der Atmungsorgane, das chron. Lungenemphysem und die Anthrakosis ausgesprochene Berufskrankheiten der Minen und Tunnelarbeiter bilden.

Die alte Ansicht, die in einer Dehnungsatrophie des Lungengewebes die primäre Ursache des Emphysems erblickt, hat durch Hofbauers[5] interessante Untersuchungen eine neue Stütze gefunden. Nach diesen Untersuchungen muss für Entstehung des Leidens an erster Stelle anstrengende Arbeit verantwortlich gemacht werden. Begünstigend wirken alle Momente, welche das Atmungsbedürfnis über die Norm steigern. In Übereinstimmung mit Hofbauers Untersuchungen finden wir daher bei Bergleuten vorwiegend das inspiratorische Emphysem der unteren Lungenlappen. und wesentlich seltener das den Glasbläsern und Musikern eigentümliche expiratorische Emphysem der oberen Lungenlappen. Es ist auch ausser Zweifel. dass die Entwickelung des Emphysems bei den Bergleuten schneller erfolgt bei muskelschwachen und schlaffen Individuen als bei robusten Personen. Die Ansicht Freund's,[6] der eine Erkrankung der Rippenknorpel und dadurch bedingte Starrheit des Brustkorbes als primäre Ursache des Emphysems annimmt. und die Auffassung Löschke's,[7] der die Toraxstarre auf chron. entzündliche Prozesse an der Wirbelsäule zurückführt, können, soweit das Emphysem der Bergarbeiter in Betracht kommt, als zutreffend nicht angesehen werden, weil meis-

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* Allgemein Knappschafts Verein.

tens eine Dehnung der unteren Lungenlappen nachweisbar ist, bevor die erwähnten Skelettveränderungen eintreten. Beide Skelettveränderungen werden aber gleichfalls durch Verrichtung schwerer körperlicher Arbeit in ihrer Entstehung begünstigt. Ermüdende Körperhaltung, staubreiche und sauersoffarme Luft, katarrhalische Affektionen der Luftwege, steigern das Atmungsbedürfnis und unterstützen so die Emphysementwickelung.

Fernhaltung muskelschwacher Personen vom Bergbau, Verbesserung der Ventilation, Verminderung des Staubes müssen andererseits die Emphysementwickelung beschränken. Vor allem werden aber alle technischen Fortschritte in der maschinellen Förderung und in der Kohlengewinnung durch Arbeitsmaschinen, die die bergmännische Arbeit erleichtern als wichtig und wirksam eingeschätzt werden müssen zur Verminderung des Emphysems. Zu diesen technischen Fortschritten gehören auch die mit Pressluft getriebenen Bohrmaschinen und Bohrhämmer, die ihre Entstehung der Ingenieurkunst dieses Landes verdanken, falls bei ihnen durch Spülvorrichtung oder Luftabsaugung die Staubbildung beschränkt wird. Ohne diese Vorrichtungen bereitem sie nach Haldane's[8] Ermittelungen durch vermehrte Staubbildung den Atmungsorganen der Arbeiter neue Gefahren.

Die Zahlen des A. K. V. geben in den letzten Jahren eine Erkrankungsziffer an Emphysem von etwa 2 pro Mille während in alten Zusammenstellungen die Morbidität mit 1 bis 2 Prozent angegeben wird. Aus dieser grossen Differenz wird man ungeachtet aller Fehlerquellen der Statistik auf eine erhebliche Abnahme des Emphysems unter den Rhein.-Westf. Bergleuten schliessen müssen.

Die Anthrakosis der Lungen erreichte ihre Anerkennung als Inhalationskrankheit bekanntlich erst durch Traube und Zenker. Der noch in neuester Zeit von Vansteenberghe und Grysez[9] gemachte Versuch sie auf einen intestinalen Ursprung zurück zu führen, hat durch zahlreiche andere Untersucher einwandsfreie Widerlegung gefunden. Ich nenne nur Schultze,[10] Cohn,[11] Bennecke, Aschoff, Rawenna, Ribbert,[12] Beitzke,[13] Macieska,[14] Tzunoda,[15] sodass der Charakter der Anthrakosis als Inhalationskrankheit nicht mehr bezweifelt werden kann. Im allgemeinen wird die Anthrakosis um so häufiger und um so leichter auftreten, je dichter und feiner der Kohlenstaub, je niedriger die Gänge, je schlechter die Ventilation und je häufiger die liegende Arbeit. Aber auch die Beschäftigungsart und das Arbeitsgerät ist, wie schon erwähnt, nicht ohne Bedeutung. Als dritter Faktor ist die Individualität der Arbeiter in Rechnung zu setzen. Alter und Gesamtconstitution des Arbeiters, die Widerstandsfähigkeit der Lunge, die normale Beschaffenheit der bronchialen Schleimhaut und des Flimmerepithels sind für die Entwickelung der Krankheit bestimmende Faktoren. Kinderarbeit, wie

Wells[16] sie schildert, muss der Entwickelung der Krankheit gefahrdrohenden Vorschub leisten. Die Bestimmung des preussischen Bergbaues, der die Beschäftigung jugendlicher Personen beim Bergbau vor vollendetem 14. Lebensjahre überhaupt und vor vollendetem 16. Lebensjahre unter Tage verbietet, ist daher für die Vermeidung dieses Leidens in hohem Masse als wirksam und segensreich zu bezeichnen. In gleicher Richtung wirkt die im Rhein.-Westf. Bergbau geübte frühzeitige Invalidisierung, durch die dem Bergmanne die Möglichkeit gegeben wird, schon frühzeitig sich leichterer Beschäftigung in und ausserhalb der Grube zuzuwenden. Im A. K. V. erfolgt die Invalidisierung schon dann, wenn durch Alter oder Krankheit eine Verminderung der Arbeitsfähigkeit eingetreten ist, die ein Drittel der vollen Arbeitskraft übersteigt. In diesen sozialhygienischen Massnahmen und in der Anwendung des Berieselungsverfahrens bei der Kohlengewinnung erblicken wir die wesentlichsten Ursachen für den Erfolg, dass schwere Formen der Anthrakosis im Rhein.-Westf. Bergbau nicht vorkommen. Obgleich in der Statistik des A. K. V. schon seit acht Jahren eine besondere Rubrik für Staubkrankheiten geführt wird, ist diese bis jetzt leer geblieben. Man kann daraus naturgemäss nur den Schluss ziehen, dass schwere Fälle von Anthrakosis den westfälischen Bergbau nicht belasten, denn wir verhehlen uns nicht, dass leichte Fälle der Anthrakosis sich des Nachweises entziehen können und, dass diese, sowie auch mittlere Fälle, je nach Art und Dauer der bergmännischen Arbeit vorliegen müssen. Die leichteren Fälle von Anthrakosis sind aber für Leben und Gesundheit des Bergmannes von untergeordneter Bedeutung.

Nach zwei Richtungen hin hat die Bedeutung der Anthrakosis eine unzutreffende Beurteilung erfahren. Es wurde ihr ein Schutz gegen Tuberkulose nachgerühmt und neuerdings wird sie beschuldigt, eine Prädisposition für akute Lungenerkrankungen zu schaffen. Beide Ansichten halten einer näheren Prüfung nicht stand. Man kann zugeben, dass der reine Kohlenstaub nicht geeignet ist, die Entstehung der Tuberkulose zu begünstigen, aber nicht, dass die Tuberkulose bei Bergleuten durch die Einwirkung des Kohlenstaubes einen langsameren Verlauf nimmt, oder gar zur Heilung gebracht wird. Bei offener Tuberkulose ist daher im Interesse des Kranken und im Interesse der gesamten Belegschaft die Grubenarbeit zu untersagen.

Die Lehre vom Antagonismus zwischen Anthrakosis und Tuberkulose findet zum Teil wohl ihre Erklärung durch unzureichende Unterscheidung zwischen Tuberkulose einerseits und chron. Pneumonie und Pneumonokoniose andererseits, Krankheitsformen, die, obgleich im Wesen und Verlauf so sehr verschieden, in ihren physikalischen Symptomen grosse Ähnlichkeit zeigen können. Auch der Umstand, dass die Pigmentierung der Lunge dort am stärksten erscheint, wo ein tuberkulöser Prozess zur Schrumpfung und Heilung gelangt ist, mag das Urteil manches Beobachters getrübt, und eine Verwechselung zwischen Ursache und Wirkung bedingt haben. Die vielfach wiederholte Behauptung, dass Kohlenstaub in feinster Verteilung das tuberkulöse Virus in seiner Wirksamkeit abschwächt,[17] ist niemals bewiesen und ist um so unwahrscheinlicher, als durch Uhlenhut's Versuche mit Antiformin die überaus grosse Widerstandsfähigkeit des Tuberkelbazillus bewiesen ist. Die Steinkohle besitzt keine antiseptische Kraft. Die in ihr schlummernden chemischen Bestandteile des Teers und der Carbolsäure werden erst lebendig bei einer Temperatur, die hoch über der menschlichen Körpertemperatur liegt.

Die tatsächlich bestehende geringe Zahl von Tuberkulösen unter den Bergleuten ist bedingt durch die Auslese bei der ärztlichen Untersuchung bei Aufnahme zur Bergarbeit und durch die Selbstauslse, indem die schwere anstrengende Arbeit schwächliche Personen von der Bergarbeit fernhält oder zur baldigen Aufgabe nötigt. Über den Verlauf der Tuberkulose entscheidet aber auch hier schliesslich die Gesamtconstitution des Kranken mit ihren Wehr- und Heilkräften.[18] Die Tuberkulose-Mortalität der Bergarbeiter Westfalens ist an sich gering, sie geht aber in ihrer abfallenden Tendenz völlig parallel der Abnahme der Tuberkulose-Sterblichkeit der Gesamtbevölkerung. In den Jahren 1903 bis 1910 sank in Preussen die Sterblichkeit an Tuberkulose von 1.97 auf 1.52, bei den Mitgliedern des A. K. V. von 1.61 auf 1.44 auf 1,000.

Es starben in Preussen an Lungentuberkulose auf 1,000 Personen im Jahre 1903, 1.97; 1904, 1.92; 1905, 1.91; 1906, 1.72; 1907, 1.71; 1908, 1.64; 1909, 1.56; 1910, 1.52.

Es starben im A. K. V. an Lungentuberkulose von Aktiven und Invaliden: 1903, 1.61; 1904, 1.55; 1905, 1.83; 1906, 1.44; 1907, 0.98; 1908, 1.43; 1909, 1.70; 1910, 1.44.

Die Auffassung Aschers und Roth's,[19] dass die Anthrakosis zu akuten Lungenerkrankungen besonders disponiere, findet in den Zahlen des A. K. V. keine Stütze; auch Gebecke [20] kommt auf grund eingehender statistischer Untersuchung aus Flügge's Institut zu einer Ablehnung dieser Meinung. Es ist wohl nicht zulässig eine gesteigerte Häufigkeit akuter Lungenerkrankungen in Städten und Industriecentren, wenn sie tatsächlich bestehen sollte, allein auf Russ und Rauch zurück zu führen. Die Gesundheitsverhältnisse der Wohnungen, der infektiöse organische Staub der Strassen, die Abhängigkeit vieler Krankheiten des Respirationsapparates von Störungen der Verdauungsorgane,[21] die Dichtigkeit der Bevölkerung und die dadurch begünstigte Übertragung von Influenza und Pneumonie [22] bilden wichtige Momente, die an Bedeutung den Kohlenstaub weit überragen.

Mit wenigen Worten möchte ich noch die angeblich bestehende relative Immunität der Bergleute gegen Carcinom berühren.

Aus Beobachtungen unter den Bergleuten in Staffortshire hat man auf eine relative Immunität der Kohlenbergleute gegen Krebs geschlossen; auch Webb und Geierswold glauben an einen Antagonismus zwischen Kohle und Krebs.[23] Zahlen, die wir im A. K. V. gewonnen haben, sind nicht geeignet, diese Ansicht zu stützen. Im Laufe eines Jahres (1910–1911) wurden bei einem Bestande von 351,188 Aktiven und 30,596 Invaliden unter 3,599 Todesfällen überhaupt 179 Todesfälle allein an Krebs der Verdauungsorgane mit Sicherheit ermittelt. Diese Erhebungen werden fortgesetzt und haben im Laufe dieses Jahres, obgleich die Feststellungen noch nicht abgeschlossen sind schon 104 Todesfälle allein durch Krebs der Verdauungsorgane ergeben. Dabei ist noch zu berücksichtigen, dass die Todesursachen der Invaliden, die wegen des höheren Lebensalters hier sehr wesentlich mit ins Gewicht fallen, nur zu unserer Kenntnis gelangen, wenn die Invaliden ihren Wohnsitz im Bezirk des Knappschafts-Vereins behalten. Schon diese wenigen Zahlen zwingen m. E. zu dem Schlusse, dass Krebserkrankungen bei den Steinkohlenbergleuten hinter der Durchschnittszahl sicher nicht zurückstehen.

M. H. Die Erkrankungen der Druckluftarbeiter, die Arteriosclerose und die Erkrankungen des Herzens infolge hoher Temperaturen der Arbeitsstätten darf ich übergehen, da diese Fragen auf diesem Congresse zum Teil schon zur Besprechung gelangten und bezgl. der ersten persönliche Erfahrungen mir mangeln. Ich bitte nun noch wenige Augenblicke bei den rheumatischen Erkrankungen verweilen zu dürfen, die nach manchen Autoren, ich nenne Moll[24] und Schirmer,[25] als die häufigsten Berufskrankheiten der Bergleute angesehen werden. Aber gerade bei diesen Erkrankungen führt die kritiklose Verwertung der statistischen Zahlen zu weitgehenden Trugschlüssen. Das wohl charakterisierte klinische Bild des akuten Gelenkrheumatismus, der seine Entstehung einer Infektion mit Streptokokken aus den verschiedensten Quellen verdankt, ist bei den Bergleuten zweifellos nicht häufiger, als bei anderen Arbeiterklassen, und unabhängig von den Schädlichkeiten des bergmännischen Berufes. Wenn in scheinbarem Widerspruche mit dieser Behauptung die Statistik des A. K. V. hohe Ziffern von akutem Gelenkrheumatismus aufweist, so kann es einem Zweifel nicht unterliegen, dass hierbei die Diagnose der alltäglichen Praxis sich mit dem klinischen Begriffe nicht dekt. Für diese Annahme spricht die geringe Zahl, die im Gegensatz zum akuten Gelenkrheumatismus der chron. Gelenkrheumatismus aufweist, die geringe Zahl der Todesfälle und die geringe Zahl der organischen Herzleiden. Nicht besser steht es mit den Zahlen des akuten Muskelrheumatismus. Erkältungseinflüsse und Anstrengung sind die beiden ursächlichen Faktoren, die bei dieser Störung als Berufsschädlichkeiten in Betracht kommen können, von denen ich geneigt bin, die Anstrengung am höchsten zu bewerten. Leichte Druckempfindlichkeit der Muskelgruppen, Schmerzhaftigkeit bei den Bewegungen und leichte Schwellung sind die stets gleichen Symptome. Zu Fehldiagnosen geben Veranlassung die Muskel- und Gliederschmerzen bei leichten Infektionskrankheiten, die Beschwerden bei Nierenleiden und Arteriosclerose, ferner Neuritiden auf alkoholischer Basis, Intoxicationen mit Blei und ähnlichen Giften, syphilitische Veränderungen an Muskeln und Gelenken.[26] Neben den Schädlichkeiten der bergmännischen Arbeit darf man aber auch hier die Bedeutung der individuellen Konstitution nicht unterschätzen. Strongeways und Barth [27] und Laumonier [28] nehmen einen ursächlichen Zusammenhang an zwischen rheumatischen Erkrankungen und Magenstörungen, Satterlee [29] eine enge Beziehung zwischen rheumatischen Erkrankungen und Stoffwechselstörungen, indem er besonders hervorhebt, dass muskuläre Überanstrengungen Störungen im Stoffwechsel verursachen. Damit ist ein Übergang gegeben ohne bestimmte Grenze zur physiologischen Muskelermüdung mit dem ihr eigenen Ermüdungsgefühl und Ermüdungsstoffen, die Weichardt als Kenotoxine bezeichnet.

Wer der Ansicht dieser Autoren sich anschliesst, wird einen günstigen Einfluss auf die rheumatischen Erkrankungen erwarten von den modernen Fortschritten in der bergbaulichen Technik, aber besonders hoch den Einfluss der Lebensweise und Lebenshaltung bewerten und in der Erfahrung, dass bei körperlicher Ermüdung das warme Bad die wirksamste Erfrischung bildet, eine ausreichende Begründung erblicken für die im Rhein.-Westf.-Bergbau durchgeführte obligatorische hygienische Massnahme, dass jedem Bergmann nach beendeter Schicht die Wohltat eines warmen Brausebades zuteil wird.

Nicht übergehen darf ich die unter den Bergleuten (Kohlenhauern) nicht seltene Berufskrankheit, den Nystagmus, dessen Wesen bekanntlich in klonischen Krämpfen der Augenmuskeln beruht, durch die den Augen des Bergmanns die Fähigkeit geraubt wird, fest und scharf zu fixieren. Eine allseitig befriedigende Erklärung des Leidens ist auch heute noch nicht gegeben. Man wird sich bescheiden müssen, als Entstehungsursache eine Überanstrengung der Augen anzunehmen, wobei nach unserer Ansicht weniger Gewicht zu legen ist auf das Bestreben des Kohlenhauers bei mangelhafter Beleuchtung deutlich zu sehen, als auf den Umstand, dass die Augen des Kohlenhauers bei der Arbeit oft eine abnorme und ermüdende Stellung einzunehmen genötigt sind. Giglioli [30] sah unter ähnlichen ungünstigen Verhältnissen Nystagmus bei einen Stubenmaler und Klempner. Nach den Erfahrungen der Praxis kann der Nystagmus der Bergleute weder als Nystagmus toxikus auf eine Kohlenoxydeinwirkung, noch als secundäres Leiden auf eine Erkrankung des Ohrlabyrinths zurückgeführt werden. Die Annahme einer coordinatorischen Neurose ist wenig vereinbar mit der grossen Differenz in der Häufigkeit des Leidens in den verschiedenen Bergbaubezirken. Nuel[31] schätzt auf Nystagmus bei 15 bis 20 Prozent der belgischen Bergleute, Rominée[32] gibt noch ungünstigere Zahlen. Vielleicht ist bisher nicht ausreichend gewürdigt die Blendung, der das Auge des Bergmanns beim Gebrauch der nach allen Seiten gleichmässig leuchtenden Wetterlampe ausgesetzt ist, ein Uebelstand dessen Beseitigung der Tecknik nicht schwer fallen kann. Dass andere Augenleiden, Trübungen der Hornhaut, Trübung des Glaskörpers, überhaupt Schwachsichtigkeit die Entwickelung des Leidens begünstigen, ist durch zahlreiche Erfahrungen sicher gestellt.

Allgemeine Körperschwäche, Blutarmut, sowie Alkoholismus sollen einen günstigen Boden für die Entwickelung der Krankheit bilden. Es ist auch nicht ausgeschlossen, dass hohe Temperatur der Arbeitsstelle, zugleich mit körperlicher und geistiger Abspannung auch diese Erschöpfungskrankheit in ihrer Entstehung begünstigt. Die theoretische Möglichkeit, dass die durch Nystagmus bedingten Sehstörungen zu Unglücksfällen Veranlassung geben können, kann nicht bestritten werden, hat aber in der Praxis ausreichende Bestätigung nicht gefunden. Wir konnten auch nicht die Annahme Snell's[33] bestätigen, dass die Nystagmuskranken erst in der Lage sind Schlagwetter zu erkennen, wenn das Gasgemisch bereits einen explosiblen Charakter angenommen hat. Einwandfreie Untersuchungen einer Anzahl Nystagmuskranker hat uns das Resultat ergeben, dass diese Leute sämtlich imstande waren, an der Benzinsicherheitslampe einen Schlagwettergehalt zwischen 2 und 3 Prozent mit Sicherheit zu erkennen. Es bleibt aber immerhin eine zweckmässige Forderung, dass Grubenbeamte und Arbeiter, die als Wetterkontrolleure oder Feuermänner Verwendung finden, praktisch auf die Zuverlässigkeit ihrer Augen geprüft werden. Der A. K. V. hat die Bestimmung, dass an Nystagmus leidene Arbeiter unter Tage nicht beschäftigt werden sollen und während der Dauer ihrer Krankheit Krankengeld und Invalidenpension beziehen. Prophyslaktisch wirkt die Bestimmung, dass Personen, deren Sehvermögen $\frac{1}{2}$ des Normalen nicht erreicht, zur Bergarbeit unter Tage nicht zugelassen werden dürfen. Heilung erfolgt nur bei Aufgabe der Grubenarbeit und bietet, falls diese rechtzeitig und auf einen längeren Zeitraum hin erfolgt, keine ungünstige Prognose.

M. H. Gestatten Sie mir noch wenige Worte über die sogenannte Anaemia montana. Dass die Minenarbeit eine besondere Form von Blutarmut erzeuge, ist eine Ansicht, die noch heute ihre Anhänger findet. Chron. Kohlensäureintoxikation soll das Wesen der Krankheit bilden. Mangelhafte Hautkultur, Durchnässung und Erkältung sollen die Entwickelung der Krankheit fördern; auch dem Mangel an Sonnenlicht während der Arbeit und der Nachtarbeit[35] hat man eine Bedeutung zugeschrieben. Nach unseren Erfahrungen und Beobachtungen in Rhein.-West. Bergbau gibt es keine besondere bergmännische Blutarmut. Bei kritischer Prüfung aller Berichte über diese Krankheit liegt die Deutung nahe, dass allein auf grund des vorherschenden Symptoms der Blutarmut in ihrem Wesen sehr verschiedene Krankheiten unter diesen gemeinsamen Krankheitsnamen zusammengefasst wurden (tiefgreifende Ernährungsstörungen im jugendlichen Alter und schwere Krankheitszustände infolge von Tuberkulose, Emphysem, Anthrakosis u. s. w.); auch ist es wohl zweifellos, dass die Anchylostomiasis irrigerweise dieser Krankheit zugezählt wurde, und man wird vorbehaltlos Leichtenstern[37] beistimmen können, dass die verschiedenen Epidemien von Blutarmut unter den Bergleuten in vorigen Jahrhundert Anchylostomiasisepidemien gewesen sind.

Auf die Anchylostomiasis selbst, die wir wenigstens für Deutschland als eine ausgesprochene Berufskrankheit der Bergleute ansehen müssen, möchte ich nicht mehr eingehen. Ich will mich darauf beschränken, hervorzuheben, dass nach unseren Erfahrungen ein mässiger Salzgehalt der Grubenwässer das Auftreten der Krankheit nicht verhindert und dass wir mit Rücksicht auf die geringe Beweiskraft des negativen Resultates der mikroskopischen Kotuntersuchung Sauberkeit im Gruben-Betriebe und die Beschaffung ausreichender Abortanlagen unter Tage für die wichtigste hygienische Massnahme zur Bekämpfung dieser Krankheit halten. Die neuesten Untersuchungen im Gelsenkirchener Institut durch Bruns[38] haben erwiesen, dass die mikroskopische Kotuntersuchung, auch unter Benutzung der Modifikationen von Telemann und Quadflieg[39] durch das von Loos ursprünglich angegebene Züchtungsverfahren von Larven an Zuverlässigkeit mehrfach übertroffen wird. Dieses Verfahren eignet sich aber, abgesehen von der Infektionsgefahr für den Untersucher, wegen seiner Umständlichkeit und Schwierigkeit nicht für die alltägliche Praxis.

M. H. Ich bin am Ende meiner Ausführungen. Die Gesundheitsverhältnisse der Bergleute zeigen nach unserer Ansicht eine fortschreitende Besserung, aber so lange der Mensch Kohle und Erz, die Hebel der modernen Kultur aus dem dunklen Schosse der Erde in emsiger und mühsamer Arbeit gewinnt, werden den Bergmann Gefahren umdrohen. Weitere Fortschritte der nie rastenden Technik, unterstützt von einem wachsenden Verständnis für bergpolizeiliche Vorschriften sanitäre Massnahmen und hygienische Lebensführung von seiten der Arbeiter werden an erster Stelle dazuführen, die Gesundheitsverhältnisse der Bergleute immer noch günstiger zu gestalten. Dass auch in diesem Sinne die Verhandlungen dieses Congresses förderlich sein mögen, das ist mein Wunsch.

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Einige Zahlen aus der Statistik des Allgemeinen Knappschaftsvereins.

Jahr.	Mittlere zahl der Belegschaft.		I. Akuter Gelenkrheumatismus.		II. Chronischer Gelenkrheumatismus.		III. Herzfehler.		IV. Muskelrheumatismus.		V. Rückenmarksschwindsucht.		VI. Neuralgie (Tschias).		VII. Augenzittern.	
			Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).
1911	357,321	Krank	3,482	9.74	196	5.48	449	1.26	30,008	83.98	....	....	3,391	9.49	1,356	3.79
		Gestorben	4	.011	....	....	22	.06	3	.008	....	....	1	.003	....	....
		Invalide	37	.10		6.32	59	.16	152	.42	9	0.02	36	.10	797	2.23
1910	351,188	Krank	3,135	8.93		4.81	510	1.45	29,746	84.73	3	.01	3,369	9.59	1,421	4.05
		Gestorben	5	.014	....	....	22	.06	1	.003	4	.01	....	....	....	....
		Invalide	52	.15	232	6.61	46	.13	151	.42	9	.02	48	.14	824	2.35
1909	348,389	Krank	2,982	8.56	131	3.76	347	1.00	29,712	85.28	2	.005	3,160	9.07	1,459	4.19
		Gestorben	6	.02	....	....	27	.08	....	....	....	....	....	....	....	....
		Invalide	62	.18	239	6.86	55	.16	176	.50	6	.02	48	.14	757	2.17
1908	343,325	Krank	2,672	7.78	302	8.08	341	.99	25,370	73.89	....	....	2,845	8.29	947	2.76
		Gestorben	3	.01	....	....	25	.07	1	.003	....	....	....	....	....	....
		Invalide	11	.03	168	4.89	38	.11	121	.35	1	.003	34	.10	406	1.18

Jahr.	Mittlere Zahl der Belegschaft.		VIII. Lungentuberculose.		IX. Krankheiten der Respirationsorgane.		X. Lungenentzündung.		XI. Staubkrankheiten.		XII. Emphysem, Asthma.		XIII. Krankheiten des Verdauungs apparates.		XIV. Anchylostomiasis.	
			Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).	Anzahl.	Auf tausend (pro mille).
1911	357,321	Krank	237	0.66	28,954	81.03	1,774	4.96	....	....	689	1.93	39,725	111.17	1,166	3.26
		Gestorben	264	.74	433	1.21	318	.89	....	....	20	.06	101	.28	....	....
		Invalide	242	.68	589	1.65	2	.01	....	....	311	.87	171	.48	....	....
1910	351,188	Krank	212	.60	26,204	74.61	1,473	4.19	....	....	666	1.90	32,527	92.62	1,306	3.72
		Gestorben	276	.78	356	1.01	259	.74	....	....	20	.06	94	.27	....	....
		Invalide	220	.63	720	2.05	3	.01	....	....	379	1.08	138	.39	1	.003
1909	348,389	Krank	163	.47	27,528	79.01	1,637	4.70	....	....	568	1.63	33,093	94.99	968	2.78
		Gestorben	305	.87	426	1.22	333	.95	....	....	19	.05	95	.27	....	....
		Invalide	202	.58	762	2.19	4	.01	....	....	444	1.27	121	.35	....	....
1908	343,325	Krank	263	.77	23,039	67.10	1,563	4.55	....	....	527	1.53	31,501	91.75	1,169	3.40
		Gestorben	272	.79	403	1.17	345	1.00	....	....	18	.05	100	.29	....	....
		Invalide	150	.44	515	1.47	5	.01	....	....	293	.85	111	.32	....	....

DISCUSSION.

Dr. R. M. CUNNINGHAM, Alabama: I concur, in the main, with the remarks of Dr. Lindemann, for the understanding of which I am indebted to the abstract of his address. I believe that anthracosis is almost universal in old coal miners and that it does not particularly affect the health so far as tuberculosis, pneumonia, and so forth, are concerned. Among old miners ephysema and moderate fibrosis of the lungs are present. The mining industry of Alabama bears the same relation to the Northern States in point of time as does that of the United States to that industry in Europe. Briefly, the mining industries in Alabama have been of importance for not more than 30 years. In the beginning cheapness and economy in the development and operation of coal mines were the rule. There has been, however, many changes for the better, so that to-day the majority of the mines in Alabama are scientifically opened and operated and are under good sanitary conditions. In addition to this, the homes and the environments of the employees have been greatly improved. This is particularly true of the mines operated by the Tennessee Coal, Iron & Railroad Co., the largest single industry of the Southern States. All houses that are now being built provide for proper sanitary conditions and comfort, and regulations have been adopted and executed that insure good hygiene in and around the home, consisting chiefly of sanitary closets, pure water, food supply, and general cleanliness in and around the works and homes of the employees.

In an investigation made by me in October of last year, out of a population of about 35,000 people, consisting of employees of the Tennessee Coal, Iron & Railroad Co. and their families, there were only about 140 cases of typhoid fever during the year, and nearly all of these lived, not in company houses, but in the near-by incorporated cities and towns over which the company has no control. From my personal experiences, excepting the tragedies of accidents, outside conditions have contributed more to disease than inside conditions. I am glad to report that in Alabama, in the Birmingham district, the officers of the industrial corporations of all kinds are taking a great interest in and are spending large sums of money to better the living conditions of their employees and to render as safe as possible the operating conditions of their industries.

I feel confident in predicting that hereafter the spirit of ethics and humanity will more largely control than ever in the past, and that the captains of industry will willingly follow the lead of science in the betterment of the living conditions of their employees, which is preferable to being driven to do so by the authority of law.

DISEASES AND ACCIDENTS OF MINERS AND TUNNEL WORKERS IN THE UNITED STATES.

Dr. JOSEPH A. HOLMES, Director, United States Bureau of Mines, Washington, D. C.

When one realizes that the mining industry of this country has nearly doubled in magnitude during each 10 years of its development, the fact that the development of the industry has not always been symmetrical becomes readily intelligible. The industry has grown so rapidly that there has not been time for full and mature organization; and, when this fact is understood, one is not surprised that in the United States questions of safety and health in mining as well as in other industries have been long neglected.

In a country like the United States, in which there is lack of continuity in the higher personnel of governmental offices, one is not surprised that governmental activities, instead of being in advance of public opinion, are usually a result of and a part of an awakening to the existence of conditions which need to be improved and regulated; and which the public believes can be improved or regulated better by governmental than by private agencies.

As a part of, and as one of the results of, the general movement in the United States in behalf of greater safety and better health conditions, Congress has recently established a Public Health Service to deal with national phases of epidemics of contagious diseases; a Bureau of Labor, which deals with general labor conditions throughout the country; and a Bureau of Mines—established only two years ago—for the conduct of inquiries and investigations looking to the improvement of conditions affecting health and safety in the different branches of the mining industry. Furthermore, in each of the more important States, there have been established improvements in local conditions, a State board of health, a State bureau of labor, and a State system for the inspection of mines. Consequently there is not only ample opportunity for the three branches of the Federal service named above to cooperate with each other; but there is also ample opportunity for each of these to cooperate with similar State institutions created for the accomplishment, within more circumscribed limits, of the same general purposes.

THE WORK OF THE BUREAU OF MINES.

The two chief purposes of Congress in creating the national Bureau of Mines are, lessening the loss of life and lessening the waste of resources in the various branches of the United States mining industry. In connection with the lessening of the loss of life, Congress has specifically assigned among the duties of the bureau the conduct of inquiries and investigations looking to the improvement of health conditions and the improvement of safety conditions in the mining industry.

Investigations looking to the improvement of safety conditions in coal mining have thus far received the larger share of attention; and in connection with this phase of the subject a special endeavor has been made to determine the causes of and the feasible means of preventing mine explosions. In this connection an extended series of investigations has been conducted concerning the explosives used in mining with the view to obtaining for use in the more dangerous coal mines a type of explosives, termed permissible explosives, that are less likely than black powder to ignite either coal dust or inflammable gas, and produce, when exploded in the mines, smaller quantities of poisonous fumes or gases dangerous to the health of miners. Though its development is based on no semblance of authority, but simply on the influence of a recommendation backed by public opinion, this new type of explosives has, within a brief period of time, been generally introduced in all of the more important coal-mining regions of the United States.

In its study of gas and dust explosions, the bureau has established and equipped not only laboratories but an experimental mine. In the latter, the recommendations suggested by laboratory results are given practical trial before being submitted for adoption by the mine owners of the country. Other investigations organized and under way relate to electric equipment in mines, mine supports, mine haulage, mine-safety appliances, mine signals, and so forth. But a number of these investigations have been started too recently to warrant expecting highly beneficial results for months or even for several years to come. Moreover, the funds at the disposal of the bureau are inadequate for pushing the work along all of these lines.

It is encouraging, however, to know that in all of this work the engineers and chemists of the Bureau of Mines are receiving the hearty cooperation of both the miners and the mine owners of the country and of the State mine inspectors. Furthermore, there has been held at Pittsburgh, Pa., during the past week, the first of a series of international conferences of the directors, engineers, and chemists of the mining experiment stations in different countries; and hereafter there may be expected a larger cooperation among the representatives of the different countries in all work on behalf of mine safety.

STATISTICS OF MINE ACCIDENTS.

In addition to the investigations mentioned above, the Bureau of Mines is endeavoring to cooperate with the States and with private corporations in the collection of full and accurate statistics of mine accidents. The statistics of coal-mine accidents are being collected on a fairly satisfactory basis by the mine inspectors in many of the coal-mining States, but in the work many difficulties have been met, and no one understands better than the inspectors themselves the fact that the results in many cases are not altogether satisfactory.

Yet every year sees an improvement, and it is hoped that within the next few years not only the system of collection but the statistics themselves will be considered reasonably complete and reliable by the entire coal-mining industry of the country.

In metal mining and quarrying the statistics of accidents are far from what they should be. A number of the States have done nothing whatever to collect such statistics. The preliminary efforts of the Bureau of Mines to collect such statistics have thus far been unsatisfactory, the funds at the disposal of the bureau for undertaking this inquiry in a satisfactory manner being entirely inadequate.

ACCIDENTS IN UNITED STATES COAL MINES.

The available statistics of coal-mine accidents in the United States are of especial interest in this connection, as indicating the lines along which investigations and more stringent legislation are needed. Thus in the underground accidents in the coal mines of the United States during the year ended December 31, 1911, statistics show that the fatalities caused by mining machines and mining machinery other than mine locomotives, or by animals, or by suffocation from mine gases, or by " blown out " or " windy " shots, were each less than 1 per cent of the total, whereas 3¼ per cent of all fatalities underground were ascribed to mine fires, 3½ per cent to electricity, 5½ per cent to explosives, 15 per cent to mine explosions (including both gas and dust explosions), 16 per cent to mine cars and locomotives, and 53½ per cent to falls of roof and falls of coal. Of the total fatal accidents connected with coal-mining operations during 1911, about 91 per cent took place underground, 2⅓ per cent in the shaft, and the remainder, 6⅔ per cent, happened in the course of work on the surface about the mines.

In the investigations of the Bureau of Mines during the past two years the larger share of attention has been given to the causes and prevention of mine explosions, although, as is shown by the figures just given, these explosions caused only 15 per cent of the total number of fatal accidents underground during the past year. The reason for giving such attention to mine explosions has been that, in other mine accidents, men are killed here and there, singly or in small numbers, and from causes that have to do largely with individual miners; whereas, in the case of mine explosions, as frequently in connection with mine fires, conditions exist that may kill hundreds of men in a few minutes.

However, the investigations of the bureau have been extended, as rapidly as appropriations for its work permit, to all the causes of mine accidents.

The accompanying statistical data indicate that, whereas prior to 1907 there was a fairly continuous increase, not only in the aggregate, but also in the proportionate number of men killed in the coal mines of the United States, yet during the past two years there has been a slight improvement in the death rate from accidents, whether this rate is based on the number of men killed for each 1,000 employed or on the number killed for each 1,000,000 tons of coal mined. The statistical tables also indicate that, although upon the basis of the number of men killed for each 1,000 men employed, the death rate from accidents in coal mines was for the years 1901–1910, 3.74 for the United States, as compared with 0.96 for India, 1.02 for Belgium, 1.04 for Austria, 1.69 for France, 1.36 for Great Britain, 2.11 for Germany, and 2.92 for Japan. On the basis of the number of men killed for each 1,000,000 tons of coal mined, the death rate for the same period was 5.83 for the United States, as compared with 4.40 for Great Britain, 5.05 for Austria, 5.56 for Belgium, 7.55 for Germany, 7.79 for France, 9 for India, and 22.71 for Japan.

WHY THERE ARE MORE MINE ACCIDENTS IN THE UNITED STATES THAN IN ANY OTHER COUNTRY.

I am frequently asked the question, especially by European mining engineers, why it is that, in proportion to the number of men employed, mine accidents are so much more numerous in the United States than in other countries. Conditions do not permit a full discussion of this question in the present paper, but I may present briefly the following factors as especially worthy of consideration at this time:

1. The industry has developed rapidly and is in an unorganized condition. A large proportion of the coal miners in the United States understand neither the language, nor the laws, nor the institutions of this country, and many of these men on entering our mines have had no previous acquaintance with either mining operations or with mining traditions. At many of our mines the ordinary rules and regulations must be printed in from three to eight different languages, and often in the same mine there will be at work at the same time miners of from 10 to 20 different nationalities.

2. The rules and regulations differ in detail at mines operated by different companies in the same coal field, in different coal fields, and in the different States; furthermore, no two States have the same mining laws. Many miners migrate frequently, not only from mine to mine and from district to district, but from State to State.

3. The system under which bituminous-coal mining in the United States is being conducted at the present time is one of severe competition, not only between different coal fields in different States, but between the different companies in each of the coal fields. The profits of the business are not such as to warrant the expenditure necessary for storage facilities at the mines, although the demand for the coal is greater during the winter than during the summer season, and this increased demand must be met by more extensive mining during the winter months. This fact and the general conditions of competition and labor have resulted in the development of mines and mining facilities capable of producing annually half again as much coal as is actually needed by the country. Furthermore, each individual miner in the United States during each day that he is at work produces three times as much coal as is produced daily by each miner in Great Britain. In consequence of the productive capacity there is frequent forced idleness at the mines; and as a result the soft-coal mines during the past few years have been operated only from 210 to 220 days during the year, as compared with a fairly constant operation for 300 days during each year in Great Britain and other European countries.

The above conditions and others which can not now be discussed help to encourage wasteful, unsafe, and unsanitary mining methods.

The preceding discussion serves to throw light on the coal mining situation as it exists in the United States to-day; but the facts stated are not offered as an excuse or an apology for the large list of fatalities. The seriousness of the situation is frankly admitted. The killing of 30,000 and the injuring of probably five times as many men in the mines and quarries of the United States during the past 10 years is plainly to our national discredit. Both our miners and mine owners are awake to the situation and are showing a commendable desire and determination to cooperate in a way to lessen this loss of life. But they need the cooperation of the statesmen of the country no less than that of the Bureau of Mines.

HEALTH CONDITIONS IN UNITED STATES MINES.

Health conditions in United States mines have been neglected, both by the State and Federal Governments, even more than matters relating to mine accidents; but plans are already under way which, it is believed, will soon result in effective cooperation between Federal, State, and private agencies, and will start an improvement in health conditions, not only at the mines, but at the various plants connected with the metallurgical and other mineral industries of the country.

During the past year preliminary inquiries begun through the cooperation of the Bureau of Mines and the Public Health Service showed the prevalence of lung troubles (silicosis) in a number of metal mines, especially those in which the ores are silicious in character. These inquiries also indicated that the hookworm disease (ankylostomiasis) has found its way into a number of the more southern coal mines, and has been reported in a few gold mines.

Furthermore, in this preliminary investigation the sanitary conditions in many of the mines have been found to be such as will promote the development of other diseases which may be directly or indirectly associated with miners' occupations.

The excellent ventilation of the coal mines of the country, developed with especial reference to the removal of explosive and noxious gases coming from the coal, from explosives, or from other sources in the mines, is one of the important agencies in bringing about the generally excellent condition of the coal mines in respect to healthfulness.

In many metal mines and tunnels, on the other hand, ventilation is wholly inadequate, being dependent only on the natural circulation of the air, with the result that the bad effects of the poisonous gases coming from explosives and other sources are often apparent. Furthermore, up to the present time no strong concerted effort has been made in most of the metal mines of the country toward keeping down the dust, which, in the silicious mines (as in the Transvaal and other mining countries), has been found to produce serious lung troubles.

In cooperation with the Bureau of Labor, the engineers and chemists of the Bureau of Mines have been making preliminary inquiries regarding health conditions in plants for treating ores and other minerals. Following up these inquiries, plans are now being matured for a more thorough investigation into health conditions and the means of improving health conditions both in the mining and metallurgical branches of the mineral industry.

WORK OF THE MINE-SAFETY CARS.

As a means of carrying forward both investigational and educational work looking to the improvement of both the health and safety conditions in the coal mines of the country, the Bureau of Mines has seven mine-safety cars in operation at the present time in the different coal fields. The equipment on each car includes such examples of equipment as can be obtained from different companies for the mine rescue work and first-aid work, besides equipment for use in sanitation and fire fighting. On each of these cars are two practical, experienced miners, who have been given special training in mine rescue and first-aid methods, and one mining engineer, who is also trained in sanitary measures. The bureau also employs a surgeon and a sanitary engineer who make general inspections. These cars are constantly traveling from one mine or group of mines to another, training at each place a small number of miners in mine rescue and first-aid methods, making examinations into mining conditions, and giving illustrated lectures before miners and mine operators concerning the possibility and the methods of making a mine safer and more healthful.

Through the agency of these traveling cars it is hoped that not only a large amount of new information will be obtained, but also a large amount of educational work will be done in the way of inducing miners and mine operators to make use of such new methods and practices as will render conditions safer and more healthful at all mines.

Whenever a mine disaster occurs in any of the coal fields of the country one or two of the mine rescue cars nearer the point of disaster proceeds there immediately. The experienced miners and the mining engineer on the car, together with other miners that have been trained in the immediate vicinity, take part in the efforts to rescue miners who may have been entombed or injured in the disaster; so that the work of the cars not only serves the purpose of carrying forward both the investigational and educational efforts of the bureau, but also serves a useful purpose in time of disaster.

THE COAL-DUST PROBLEM.

In conclusion, I may add a few observations to Sir Thomas Oliver's most excellent and valuable address given last evening. Keeping in close touch with the coal-dust investigations that have been in progress during the past two or three years in England, Belgium, France, Germany, and Austria, the Bureau of Mines has been conducting investigations into the causes and possible prevention of coal-dust explosions. On the whole, its results have been similar to those obtained in other countries, as outlined by Sir Thomas Oliver.

We have begun experiments to determine, if practicable, the value of the application of stone dust, calcium and magnesium chloride, and so forth, in preventing or limiting explosions. From observations made in this country through a number of years, we now have very little fear of dust explosions during the late spring, summer, and early autumn, for the reason that during these months the warm air entering the mine is cooled by coming in contact with the mine walls, and the contained moisture is deposited, keeping up a continuous "sweating." Thus the coal dust is so moistened that we have thus far been unable to explode it in the mine except when gas is present in sufficient quantities to start in advance a vigorous explosion. The great problem in connection with coal dust is its treatment during the cold winter months when the cool air entering the mine has its temperature raised and, instead of depositing moisture, removes both the natural moisture and any brought in for sprinkling the coal dust, leaving the dust dangerously dry.

The simplest remedy we have found for this condition is the introduction of exhaust steam from the mine power plant, in such a manner and in such quantities as to raise the temperature of the entering air and at the same time to supply it with moisture.

It is of course realized that this introduction of warm, moist air throughout the winter season may result in developing and maintaining conditions favorable to the spread of the hookworm disease, and that an atmosphere of this kind may tend to make miners work with less energy than would a drier atmosphere, but, through an experience of three years in a number of our larger coal mines, neither one of these evils has appeared, nor has there been any serious resulting trouble in the way of damage to the mine roof.

In the use of this method of humidifying mine air it is important that neither the temperature of the entering air nor the amount of moisture turned into the air in the form of exhaust steam should exceed what is necessary to accomplish the desired result. Further, it is important that the supply be continuous, as alternate increase or decrease of temperature or of moisture are likely to have injurious effects on the roof of the mine.

Statistics of coal-mine accidents in the principal coal-producing countries of the world.

[Averages from 1901 to 1910, inclusive.]

	India.	Belgium.	Austria.	Great Britain.	France.	Germany.	Japan.	United States.
Number killed per 1,000 employed..	0.96	1.02	1.04	1.36	1.69	2.11	2.92	3.74
Number killed per 1,000,000 short tons mined......	9.00	5.56	5.05	4.40	7.79	7.55	22.71	5.83
Production in short tons.......	10,112,000	25,540,000	14,046,000	274,794,000	38,785,000	134,785,000	13,604,000	389,269,000
Number employed	94,346	139,597	68,288	890,434	178,749	482,132	105,924	607,438

Production, number of men employed, and number of men killed in and about the coal mines of the United States in the calendar year 1910.

State.	Production (short tons).[1]	Number employed.[1]	Number killed.			Production per death (short tons).
			Total.	Per 1,000 employed.	Per 1,000,000 short tons mined.	
Alabama	16,111,462	22,230	238	10.71	14.77	68,000
Arkansas	1,905,958	5,568	14	2.51	7.35	136,000
California and Alaska	12,164	19	0	0	0	....
Colorado	11,973,736	15,864	323	20.36	26.98	37,000
Georgia	177,245	386	0	0	0	....
Idaho	4,448	14	0	0	0	....
Illinois	45,900,246	72,645	143	1.97	3.12	321,000
Indiana	18,389,815	21,878	51	2.33	2.77	361,000
Iowa	7,928,120	16,666	33	1.98	4.16	240,000
Kansas	4,921,451	12,870	17	1.32	3.45	290,000
Kentucky	14,623,319	20,316	86	4.23	5.88	170,000
Maryland	5,217,125	5,809	17	2.93	3.26	307,000
Michigan	1,534,967	3,575	6	1.68	3.91	256,000
Missouri	2,982,433	9,691	14	1.44	4.69	213,000
Montana	2,920,970	3,837	12	3.13	4.11	243,000
New Mexico	3,508,321	3,585	16	4.46	4.56	219,000
North Dakota	399,041	534	2	3.75	5.01	200,000
Ohio	34,209,668	46,641	161	3.45	4.71	213,000
Oklahoma	2,646,226	8,657	40	4.62	15.12	66,000
Oregon	67,533	153	0	0	0	....
Pennsylvania (anthracite)	84,485,236	169,497	601	3.55	7.11	141,000
Pennsylvania (bituminous)	150,521,526	175,403	539	3.07	3.58	279,000
Tennessee	7,121,380	11,930	38	3.19	5.34	187,000
Texas	1,892,176	4,197	7	1.67	3.70	270,000
Utah	2,517,809	3,053	15	4.91	5.96	168,000
Virginia	6,507,997	7,264	57	7.85	8.76	114,000
Washington	3,911,899	6,314	43	6.81	10.99	91,000
West Virginia	61,671,019	68,663	329	4.79	5.33	187,000
Wyoming	7,533,088	7,771	38	4.89	5.04	198,000
Total	501,596,378	725,030	2,840	....	....	....
Average	....	....	....	3.92	5.66	177,000

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[1] Parker E. W., Mineral Resources, U. S., 1910: U. S. Geol. Survey, 1911.

Number of men killed in and about the coal mines of the United States in the calendar year 1910.

State.	Killed underground.											Killed in shaft.						Killed on the surface.							Total by States.
	By falls of roof (rock, coal, etc.).	By mine cars and locomotives.	By gas or dust explosions, windy or blown-out shots.	By explosives.	By suffocation from mine gases.	By electricity (shock or burns).	By animals.	By machinery other than locomotives but including mining machines.	By gases from mine fires.	By other causes.	Total.	By falling down shafts or slopes.	By objects falling down shafts or slopes.	By breaking of cables, chains, etc.	By overwinding.	By other causes.	Total.	By mine cars and mine locomotives.	By electricity (shock or burns).	By machinery.	By boiler explosions.	By railway cars and locomotives.	By other causes.	Total.	
Alabama	55	20	139	10	....	6	....	1	....	7	238	....	....	....	....	....	0	....	....	....	....	....	....	0	238
Alaska	....	....	....	....	....	....	....	....	....	....	0	....	....	....	....	....	0	....	....	....	....	....	....	0	0
Arkansas	10	....	4	....	....	....	....	....	....	....	14	....	....	....	....	....	0	....	....	....	....	....	....	0	14
California	....	....	....	....	....	....	....	....	....	....	0	....	....	....	....	....	0	....	....	....	....	....	....	0	0
Colorado	73	18	210	5	....	....	....	....	12	....	318	2	....	....	....	....	2	1	....	....	....	....	2	3	323
Georgia	....	....	....	....	....	....	....	....	....	....	0	....	....	....	....	....	0	....	....	....	....	....	....	0	0
Idaho	....	....	....	....	....	....	....	....	....	....	0	....	....	....	....	....	0	....	....	....	....	....	....	0	0
Illinois	74	27	8	9	....	1	4	....	....	....	123	5	2	....	....	6	13	1	....	....	....	4	2	7	143
Indiana	25	6	6	9	....	1	....	....	....	....	47	3	....	....	....	1	4	....	....	....	....	....	....	0	51
Iowa	21	4	1	2	....	....	1	....	....	....	29	3	....	....	....	....	3	1	....	....	....	....	....	1	33
Kansas	7	1	1	3	....	....	....	....	....	....	12	4	....	....	....	....	4	....	....	....	....	....	1	1	17
Kentucky	21	5	50	6	1	2	....	....	....	....	85	....	....	....	....	....	0	1	....	....	....	....	....	1	86
Maryland	10	3	....	1	....	....	....	....	....	1	15	....	....	....	....	....	0	1	....	....	....	....	1	2	17
Michigan	4	....	....	1	....	....	....	....	....	1	6	....	....	....	....	....	0	....	....	....	....	....	....	0	6
Missouri	8	3	....	1	....	....	....	....	....	2	14	....	....	....	....	....	0	....	....	....	....	....	....	0	14
Montana	7	3	....	....	....	....	....	....	....	....	10	....	....	2	....	....	2	....	....	....	....	....	....	0	12
New Mexico	15	....	....	1	....	....	....	....	....	....	16	....	....	....	....	....	0	....	....	....	....	....	....	0	16
North Dakota	1	....	....	1	....	....	....	....	....	....	2	....	....	....	....	....	0	....	....	....	....	....	....	0	2
Ohio	103	16	17	4	....	7	....	2	....	....	149	3	....	....	....	....	3	5	....	1	....	2	1	9	161
Oklahoma	11	3	16	....	....	....	....	....	....	1	31	....	....	....	....	2	2	....	....	1	....	1	5	7	40
Oregon	....	....	....	....	....	....	....	....	....	....	0	....	....	....	....	....	0	....	....	....	....	....	....	0	0
Pennsylvania (anthracite)	253	92	20	82	13	3	1	2	....	24	490	19	....	....	....	....	19	[1] 40	....	27	....	....	25	92	601
Pennsylvania (bituminous)	306	107	15	10	....	30	1	5	....	1	475	9	....	....	....	....	9	[1] 28	5	8	3	....	11	55	539
Tennessee	22	3	....	10	....	2	....	....	....	....	37	....	....	....	....	....	0	1	....	....	....	....	....	1	38
Texas	4	1	....	....	....	1	....	....	....	1	7	....	....	....	....	....	0	....	....	....	....	....	....	0	7
Utah	8	2	....	1	....	....	....	1	....	....	12	....	....	....	....	....	0	3	....	....	....	....	....	3	15
Virginia	35	1	10	....	....	3	....	3	....	2	54	....	....	....	....	....	0	1	....	....	....	2	....	3	57
Washington	9	5	18	4	....	3	....	....	....	3	42	....	....	....	....	....	0	....	....	....	....	1	....	1	43
West Virginia	203	51	3	8	....	20	1	4	....	1	291	9	....	....	....	5	14	18	....	1	....	2	3	24	329
Wyoming	25	4	....	8	....	....	....	....	....	....	37	....	....	....	....	....	0	....	....	....	....	....	1	1	38
Total	1,310	375	518	176	14	79	8	18	12	44	2,554	57	2	2	....	14	75	101	5	38	3	12	52	211	2,840
Per cent of total	46.13	13.21	18.24	6.20	0.49	2.78	0.28	0.63	0.42	1.55	89.93	2.01	0.07	0.07	....	0.49	2.64	3.56	0.18	1.34	0.10	0.42	1.83	7.43	100.00

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[1] Includes those killed by railway cars.

Number of men killed in and about the coal mines of the United States in the calendar year 1911.

State.	Killed underground.															Killed in shaft.						Killed on the surface.							Total by States.
	By falls of roof (rock or coal).	By falls of coal (other than roof coal).	By mine cars and locomotives.	By gas explosions and burning gas.	By coal-dust explosions.[1]	By "blown-out or windy shots."	By explosives (includes premature blasts, explosion of misfires, suffocation by gases from explosives, by flying pieces from blasts, etc.).	By suffocation from mine gases.	By electricity (shock or burns).	By animals.	By mining machines.	By machines other than locomotives and mining machines.	By mine fires (burned, suffocated, etc.).	By other causes.	Total number killed inside of mines.	By falling down shafts or slopes.	By objects falling down shafts or slopes.	By breaking of cables, chains, etc.	By overwinding.	By other causes.	Total killed by shaft accidents.	By mine cars and mine locomotives.	By electricity (shock or burns).	By machinery.	By boiler explosions.	By railway cars and locomotives.	By other causes.	Total.	
Alabama	46	1	14	2	128		5		6					2	204	1					1					2	2	4	209
Alaska															0						0							0	0
Arkansas	9		1											1	11					1	1							0	12
California															0						0							0	0
Colorado	41	6	12		17	1	1	2	2		1			1	84					2	2	2				3		5	91
Georgia															0						0							0	0
Idaho															0						0							0	0
Illinois	70	16	40	1	8		13		3	1				1	153	8	1			3	12	1		1		1	4	7	172
Indiana	17	2	4	1	2	1	10		2		1				40	3					3	1				1	1	3	46
Iowa	22		12								1			1	36	2	1	1			4							0	40
Kansas	20			7		3	3	3	1					3	40	1					1				1			1	42
Kentucky	26	1	3		1		3		4		1			2	41						0	1		1		2		4	45
Maryland	12		1											1	14						0					1		1	19
Michigan	3	1							2					1	7						0							0	5
Missouri	6	1													7						0					1		1	7
Montana	7	3	2				1								13						0							0	18
New Mexico	14	2	1				1								18						0			2		1		3	23
North Dakota							1								1						0							0	1
Ohio	78	12	12				1		3		2				108						0					1		1	101
Oklahoma	9		6	3		4	4		1				2		29					4	4							0	33
Oregon	1														1						0							0	1
Pennsylvania (bituminous)	281	36	95	22	8		3	1	35	2	3	1		9	496	2				2	4	7	1	3		6	12	29	529

[1] These dust explosions may have been started by powder or gas explosions or other causes.

Number of men killed in and about the coal mines of the United States in the calendar year 1911—Continued.

State.	Killed underground.															Killed in shaft.						Killed on the surface.							Total by States.
	By falls of roof (rock or coal).	By falls of coal (other than roof coal).	By mine cars and locomotives.	By gas explosions and burning gas.	By coal-dust explosions.	By "blown-out or windy shots."	By explosives (includes premature blasts, explosion of misfires, suffocation by gases from explosives, by flying pieces from blasts, etc.).	By suffocation from mine gases.	By electricity (shock or burns).	By animals.	By mining machines.	By machines other than locomotives and mining machines.	By mine fires (burned, suffocated, etc.).	By other causes.	Total number killed inside of mines.	By falling down shafts or slopes.	By objects falling down shafts or slopes.	By breaking of cables, chains, etc.	By overwinding.	By other causes.	Total killed by shaft accidents.	By mine cars and mine locomotives.	By electricity (shock or burns).	By machinery.	By boiler explosions.	By railway cars and locomotives.	By other causes.	Total.	
Tennessee	15	....	6	....	84	....	1	....	1	....	....	....	....	1	108	......	....	....	....	......	0	3	1	......	....	1	2	7	115
Texas	5	....	1	....	......	....	2	....	....	....	....	....	....	....	8	......	....	....	....	......	0	......	....	......	....	......	......	0	8
Utah	7	3	2	....	......	....	......	....	....	....	....	....	....	....	12	......	....	....	....	......	0	......	....	......	1	1	......	2	14
Virginia	35	....	18	5	......	....	......	....	2	....	....	....	....	....	60	......	....	....	....	......	0	4	....	......	....	......	4	8	68
Washington	11	....	6	....	......	....	2	1	2	....	....	....	....	....	22	2	....	....	....	......	2	2	....	1	....	......	......	3	27
West Virginia	166	28	58	27	23	....	2	....	20	1	4	....	....	1	330	2	....	....	....	......	2	5	4	2	....	3	4	18	350
Wyoming	18	8	2	1	......	....	1	....	....	....	....	....	....	1	31	......	....	....	....	......	0	1	....	1	....	......	......	2	33
Total (bituminous)	919	120	296	69	271	9	54	7	84	4	13	1	2	25	1,874	21	2	1	0	12	36	27	6	11	2	24	29	99	2,009
Pennsylvania (anthracite)	254	28	97	30	......	....	80	1	3	3	....	1	78	24	599	21	2	2	1	1	27	18	1	22	1	8	34	84	710
Grand total	1,173	148	393	99	271	9	134	8	87	7	13	2	80	49	2,473	42	4	3	1	13	63	45	7	33	3	32	63	183	2,719
Per cent of grand total	43.14	5.44	14.45	3.64	9.97	0.33	4.93	0.29	3.20	0.26	0.48	0.08	2.94	1.80	90.95	1.54	0.15	0.11	0.04	0.48	2.32	1.65	0.26	1.21	0.11	1.18	2.32	6.73	100.00
Per cent of total underground, total shaft, and total surface fatalities	47.43	5.98	15.89	4.00	10.96	0.36	5.42	0.33	3.52	0.28	0.53	0.08	3.24	1.98	100.00	66.67	6.35	4.76	1.59	20.63	100.00	24.59	3.82	18.03	1.64	17.49	34.43	100.00	......

Production, number of men employed, and number of men killed in and about the coal mines of the United States in the calendar year 1911.

State.	Production (short tons).[1]	Number employed.	Number killed.			Production per death (short tons).
			Total.	Per 1,000 employed.	Per 1,000,000 short tons mined.	
Alabama	15,021,421	22,003	209	9.50	13.91	72,000
Arkansas	2,106,789	5,338	12	2.25	5.70	176,000
California and Alaska	11,647	60	0	0	0	....
Colorado	10,157,383	14,373	91	6.33	8.96	112,000
Georgia	165,330	510	0	0	0	....
Idaho	1,821	9	0	0	0	....
Illinois	53,679,118	75,656	172	2.27	3.20	312,000
Indiana	14,201,355	20,991	46	2.19	3.24	309,000
Iowa	7,331,648	16,852	40	2.37	5.46	183,000
Kansas	6,254,228	11,823	42	3.55	6.72	149,000
Kentucky	13,706,839	24,124	45	1.87	3.28	305,000
Maryland	4,685,795	6,079	15	2.47	3.20	312,000
Michigan	1,476,074	3,248	7	2.16	4.74	211,000
Missouri	3,760,607	9,607	8	8.33	2.13	470,000
Montana	2,976,358	3,864	13	3.36	4.37	229,000
New Mexico	3,148,158	3,700	21	5.68	6.67	150,000
North Dakota	502,628	760	1	1.32	1.99	503,000
Ohio	30,759,986	45,459	109	2.40	3.54	282,000
Oklahoma	3,074,242	8,729	33	3.78	10.74	93,000
Oregon	46,661	304	1	3.29	21.28	47,000
Pennsylvania (anthracite)	90,464,067	173,940	710	4.08	7.85	127,000
Pennsylvania (bituminous)	144,754,163	171,108	529	3.09	3.65	274,000
Tennessee	6,433,156	11,124	115	10.34	17.88	56,000
Texas	1,974,593	4,980	8	1.61	4.05	247,000
Utah	2,513,175	3,446	14	4.06	5.57	180,000
Virginia	6,864,667	8,107	68	8.39	9.91	101,000
Washington	3,572,815	7,236	27	3.73	7.56	132,000
West Virginia	59,831,580	66,800	350	5.24	5,85	171,000
Wyoming	6,744,864	8,118	33	4.07	4,89	204,000
Total	496,221,168	728,348	2,719	....	....	....
Average	....	....	....	3.73	5.48	183,000

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[1] Kindly furnished by E. W. Parker in advance of publication in Mineral Resources, U. S., 1911: U. S. Geol. Survey.

INJURIES CAUSED BY ELECTRICITY.

Sir Thomas Oliver, M. D., Newcastle-on-Tyne, England.

The increasing use to which electricity is put has opened up new sources of danger to life, but more accurate knowledge of the generation and distribution of electrical currents will enable man to anticipate these dangers and to obviate them. Hardly a week passes without the public being reminded through the daily press of the deadly effects of electricity, whether employed for illuminating purposes, as a transporting agent, or in bringing about decomposition and reconstruction of chemical compounds, thereby inaugurating new processes of manufacture, and to which the prosperity of modern chemical industry is largely due. The subtle fluid will forever remain a source of danger to the unwary. The effects of powerful currents resemble lightning stroke, with the difference that, while death in lightning stroke is direct, and is due to destruction or alteration of the tissues, death in electric shock is the result of effects produced upon the heart, respiration, and the nervous system. Contact with a live wire or an unprotected piece of machinery may kill a person outright. If not killed immediately, the man may be so severely injured that he dies a few days afterwards, or he is extensively burned and recovers slowly, with perhaps loss of part of a limb. Death may be immediate without any noticeable change on the surface of the body; usually, however, there are marks of burning or other external signs indicative of the penetration and exit of the current. When a workman has grasped live metal, he may be unable to relax his grip, or his body is thrown forward a short distance, as if impelled by some titanic force.

We do not know what pressure of electrical current exactly comes within the limits of safety. In the remarks which follow, by the term "voltage" is meant pressure, tension, or electromotive force, and by "milliampérage," the intensity of electrical current. In comparing an electrical current with a stream of water falling from a great height, voltage or tension would be represented by the height of the waterfall, and intensity by the section of the stream. Of the two kinds of currents, the alternating is more dangerous than the continuous. Tesla and D'Arsonval are, however, of opinion that while alternating currents of low tension may be dangerous, they become less dangerous when their value is higher. Electrical currents with an intensity of 20 milliampères will cause pain, but Kammerer[1] states that a milliampèrage of 50 to 60 will cause serious harm, and that 100 will be probably fatal. As regards the harmful effects produced by electricity, the current is usually spoken of in terms of voltage, so that when a fatal accident has occurred the question is generally asked with what voltage was the wire or metal charged at the time of the accident? We can not always say what voltages are safe, for there are several circumstances in operation at the time of the accident to modify the action of the electrical current. One man was killed near Prague through contact with a wire charged with a pressure of 95 volts, and yet electricians can touch wires carrying currents of such high tension as 5,000 volts without experiencing any ill effects. Jellinek maintains that the tension of an electrical current is the first point to be determined in our consideration as to whether a current is to be regarded as dangerous or not. Although a current of 100 to 150 volts is usually regarded as within the limits of safety, 200 to 300, as coming within the danger sphere, and anything above 600, as likely to be fatal, there is no absolute certainty in this statement.

When framing regulations, it was the opinion of the dangerous trades committee of the British Home Office that currents of 700 volts direct and 350 alternating should be regarded as dangerous. On the other hand, while the Board of Trade makes no distinction as to what are safe and unsafe voltages, 250 volts is the maximum it allows electricity supply undertakers to take into private consumers' premises. In the United States, the voltage recommended for the electrocution of criminals is 1,500, but contact with even such a high voltage has not always caused immediate death, for the heart of the electrocuted person has commenced to beat again, and respiration to be restarted, so that fresh electrical contact had to be made. Mode of contact and duration of application are important factors, for the longer the application of the current, the greater is the danger, owing to the resistance of the skin becoming diminished. When, after a severe shock, unconsciousness does not supervene, fear may cause the injured workman to faint. Contact with both poles is more dangerous than contact with one pole alone, since a more effective circuit is formed. The skin offers most resistance to the passage of electrical currents. The resistance is measured in terms of ohms. Much depends upon the condition of the skin at the time of contact, viz, whether it is dry or moist. The hard, thickened, and dry skin of a workman's hand is less favorable to the penetration of an electrical current than where the skin is delicate and moist. Resistance to current occurs mainly at the point of penetration in the skin and the point of exit, for the resistance offered by the deeper tissues is slight. With few exceptions, the point of exit from the body for the current is the feet. As contact is for the most part unipolar, and is generally made by the hands or arms of a workman, the current, after traversing the body, escapes to earth by the feet, so that the condition of the boots of the workman at the time of the accident and the condition of the soil upon which he is standing, viz, wet or dry, will determine whether an electrical current prove fatal or not.

Alternating currents are almost twice as dangerous as continuous. There is a difference in their action. Continuous currents at high tension cause severe burning and great local destruction of tissue, but, with alternating currents, although burns appear, there is less burning and less local destruction of tissue. It is characteristic of the burns caused by electricity that they are red, angry looking, painful, slow to heal, and that they extend deeply into the tissues, exposing bone. When an electrical current penetrates the skin, none of its energy is lost; it is simply transformed into mechanical, thermal, chemical, and electrolytic action. While the effects produced are the result of the combined influence of all of these, they are, for the most part, of a thermal and electrolytical nature.[2] The heat which is generated, and which is an accompaniment of the tetanic rigidity of the muscles, is considerable. Decomposition of the tissues caused by electrolysis is none the less a noticeable feature. The ions formed under these circumstances possess chemical affinities, whereby new compounds born of tissue decomposition are formed. It is possible that it is to the operation of these toxins that many of the pathological effects produced by electrical currents are due. It is thus that the burns caused by electricity differ from those produced by other means. The skin at the point of penetration undergoes changes of texture and color consequent upon excessive heat, the deeper tissues may be charred, torn, or completely removed, and yet these local injuries can hardly be altogether regarded as burns, since, unlike burns, they are not altogether due to extension from the surface, but to intense internal heat.

I repeat, the effects produced by electrical currents upon the body depend largely upon the manner in which the currents enter. Good contact, a moist skin, and damp boots will transform an electrical current which would probably have been regarded simply as hazardous into one of a fatal character. Men working on electrified railways ought therefore to remember that the danger is greatest in wet weather. The danger consists in one foot touching a live rail, while the other foot is on the wet earth. The periods of danger are the making and breaking of electrical contacts, for, as the current continues to pass, the resistance of the body is diminished. During the electrocution of the criminal MacElwan, in the United States, the resistance fell from 800 to 516 ohms in a little less than one minute, and a few seconds after, when another current had been passed, it was found that the resistance had fallen to 214 ohms.

I shall briefly mention three cases of severe electrical injuries which came under my own observation, one of which terminated fatally. One wet day, a man accidentally placed his foot on a live rail, and was immediately thrown down. He was rescued by a signal man, wearing India-rubber gloves. When seen by Dr. Alfred Wilson, of Wallsend, with whom I saw the patient in consultation, the man was the subject of recurrent convulsions and was unconscious. He remained unconscious for several hours. Although his boots and clothing were untouched, yet, on removing his boots, the feet were found to be the seat of angry-looking sores on the heel, and the bone was exposed. The burns were slow in healing. There was no return of the nervous symptoms, and the man made a good recovery.

The second case is that of a youth of 18, who was admitted into the Royal Victoria Infirmary under the care of my surgical colleague, Mr. Angus, who has kindly allowed me the use of his notes. This youth, while standing on a concrete floor, touched a wire carrying 6,000 volts alternating current with his right hand, and received a severe shock. The palmar aspect of the right hand was deeply charred, so, too, but to a less degree, the plantar surface of the right toes. The skin beneath the left toes was only slightly burned. Later on the burnt tissues of the right hand sloughed and the flexor tendons were exposed. In consequence of gangrene setting in, several of the phalanges had to be amputated, and upon the palmar aspect of the hand a large graft of skin was successfully applied.

The third case was that of a man of 22, a laborer, who was admitted into the Royal Victoria Infirmary, Newcastle-upon-Tyne, in a state of unconsciousness. He had, when working at a power station, received an electric shock from a current of 20,000 volts. I saw him with Dr. E. L. Markham, one of the house surgeons, about 2½ hours after the accident. There were several large burns on the shoulders, abdomen, and limbs, also a deep wound on the back of the head, exposing the occipital bone. The pulse was rapid—about 150 to the minute. The heart's sounds were feeble; the pupils were dilated, corneal reflexes were present, and there was profuse perspiration. Shortly afterwards, Cheyne-Stokes respiration developed. Within 7 hours after his admission into the infirmary, the patient died, never having regained consciousness.

At the post-mortem examination, in addition to the large superficial burns, there were found, on removing the calvarium, acute inflammatory changes in the diploe of the right occipital bone, immediately underlying the superficial burn. On section of the brain, a hemorrhage about the size of a walnut was found in the substance of the occipital lobe corresponding to the wound on the surface. The hemorrhage in the brain was surrounded by softened tissue and by numerous petechial hemorrhages in the white matter. Nearly all the internal organs were congested. The bladder was full of blood-stained urine, free from sugar. Portions of brain were submitted to Dr. Frederick W. Mott and Dr. Schuster for examination. These gentlemen reported that, in addition to naked-eye hemorrhages, there were found, on microscopical examination, others due to ruptured vessels, both in the cortex and the subjacent white matter of the brain. The blood in places showed evidence of haemolysis. All the ganglion cells of the cortex showed chromolytic changes. Not one cell could be seen exhibiting the normal Nissl pattern. The large and small cells of the medulla oblongata also showed marked chromolytic changes.[3]

When a person receives a fatal electric shock there is usually heard a cry. This attracts the attention of fellow workmen who may be at hand, and by it they are directed to the spot where is lying the apparently lifeless body of their comrade. The face of the injured is pale or cyanosed. The heart is no longer beating, the pupils are dilated, and mucus is perhaps oozing from mouth and nose. The hand may still be grasping the live metal, or, if contact has been broken, the body may have been thrown forward several feet from the site of the accident.

In conjunction with my colleague, Prof. Robert A. Bolam, I carried out a series of experiments with the view of determining the cause of death in electric shock. We employed continuous currents. In most of the animals death was due to sudden arrest of the heart's action. If the contact is good, high electrical currents throw the body of an animal into a condition of extreme rigidity, as in opisthotonos. On breaking the current, respiration becomes quicker and deeper, and the heart gradually returns to its normal beat. In the case of one dog apparently killed by an electrical current, the heart having ceased to beat, the animal yet barked for fully a minute; but, notwithstanding this fact, the beat of the heart was not again restored. Before commencing these experiments I had been under the impression that in death in electric shock the respiration would be the first affected, but our experiments indicated that with electrical pressures of 250 volts death came from the heart, and that with higher voltages heart and respiration ceased simultaneously. That death came from the heart and not from the medulla oblongata was shown by the fact that when the pneumogastric nerves were divided the result was in no way affected.

MM. Prévost and Batelli, of Geneva, carried out similar experiments. They found that currents of low tension cause death by the heart becoming paralyzed. This organ is thrown into fibrillary tremor. With currents of higher tension the animal is killed outright by arrest of the breathing through inhibition of the respiratory center. With alternating currents of low tension, e. g., 120 volts, Prévost and Batelli found that the heart is the first organ attacked and that with high voltages, e. g., 1,200 to 4,800, respiration is arrested through inhibition of the respiratory center. It would appear, therefore, as if the effects of continuous current of low voltage are mainly observed on the heart. Fifty volts is sufficient to induce fibrillary tremor of the heart. In employing alternating currents of 550 volts, Prévost and Batelli found that the heart was suddenly arrested, and that after suspended respiration for several seconds breathing would recommence, continue for a short time, and then gradually become feebler and feebler, until death ended the scene. Grange[4] considers that death comes through cardiac and respiratory failure, owing to hemorrhages into the medulla oblongata pressing upon the origin of the pneumogastric nerves. Jellinek found on lumbar puncture evidence of high cerebrospinal pressure in death following electric shock. This observer is of the opinion that death is the outcome of two factors, psychical and anatomical, and that the anatomical plays the more important part. In Jellinek's experiments death was mostly due to cardiac arrest, but in other experiments heart and respiration ceased together, while in still others death came through the respiratory center. Kammerer[5] gives a short list of fatalities caused by low voltages:

At Prague, a man working in a potassium factory, 95 volts, 1 death.
At Oscherleben, men working in a sugar factory, 230 volts, 4 deaths.
At Fulham Baths, 200 volts, 2 deaths.
At Vieux Thann, a foundry, 220 volts, 1 death.
At Cannaux, mines, 240 volts, 1 death.

To which may be added:[6]

At Ivry Station (1904), 200 to 400 volts, 2 deaths.
At Puteaux (1909), owing to the short circuiting of a lamp in a kitchen, 110 volts, 1 death.

LOCAL EFFECTS—BURNS, CONJUNCTIVITIS.

Exposure to strong electric light may be followed by erythema of the skin, resembling that produced by the intense rays of the sun. The burns caused by electrical currents are red and angry looking. They heal slowly, owing to the peculiar effect produced by the current upon the cells of the tissue and the destruction of nerve fibers.

In consequence of exposure to powerful electrical illumination vision may be temporarily lost, or conjuctivitis may develop. If the eyes have been brought into close contact with the light there may be, in addition to conjunctivitis, myosis and slight opacities on the cornea or minute erosions of it. There may be photophobia and excessive lachrymal secretion. Electric sparking is a source of danger to the eyes. The skin, eyebrows, and eyelashes may be burned and the conjunctiva becomes hyperaemic. The inflammation is followed by a muco-purulent secretion. The iris and retina may suffer and vision be rendered defective for a considerable length of time. After recovery has taken place persistent neuralgia is apt to remain.

The treatment of electrical injuries is local and general. Into the treatment of local injuries, such as burns, I do not propose to enter. General treatment is preventive and curative. To all persons working in electricity the danger of the occupation should be pointed out, and only intelligent men employed. It is the unskilled laborers who so frequently get caught. When a person has received a severe electrical shock the first thing a rescuer has to do is to sever the contact by cutting the wire, care being taken to protect the hands by dry cloths. The greatest care must be exercised in removing the body from contact with the live metal, and especially so if the workman's clothes are damp. These should be grasped only if they are dry. India-rubber gloves are the best protectives. Since every moment is of importance, and gloves may not be immediately procurable, rescuers ought to wrap their hands with thick dry rags before attempting to pull away the apparently lifeless body of a fellow workman. Placing the body on its back, and sending for medical assistance, the men should at once resort to artificial respiration, and continue it for a long time, imitating, as far as possible, the natural movements of respiration, viz, at the rate of about 16 to the minute. By means of artificial respiration continued for half an hour to an hour, many lives apparently brought to a close by electric shock have been restored.

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[1] Bulletin de la Société Industrielle de Mulhouse, juin–juillet, 1904.

[2] Jellinek, Bulletin de la Société Industrielle de Mulhouse, juin-julliet 1904.

[3] Treatment of Injuries coused by Electricity, Sir Thomas Oliver, Lancet, Feb. 11, 1911, p. 363.

[4] Lancet, Aug. 20, 1904.

[5] Bulletin de la Société Industrielle de Mulhouse.

[6] Report "d'une commission chargée d'élaborer le texte de l'instruction sur les premiers soins à donner aux victimes des accidents électriques; p. 67, Paris, Déc., 1910."

DISEASES AND INJURIES OCCURRING IN ELECTRIC GENERATING PLANTS.

Dr. J. D. McGowan, Chicago, Ill.

The facts set forth in this paper are obtained through a service of 13 years as surgeon with the Commonwealth Edison Co. and 10 years with the Chicago Telephone Co. In the former organization semiannual inspections of all employees are held for the purpose, eliminating all who may be suffering from disease and providing them with occupations or placing them in an environment conducive to their recovery. All new applicants for positions are examined physically before being assigned to permanent employment.

By this method we have discovered many cases of tuberculosis, the victims of which disease are given situations in the Western States particularly suited to their cases, which enables them to prolong their lives and diminish their discomfort, at the same time removing them from contact with their fellow employees and thus preventing the spread of the disease throughout the organization.

These cases of tubercular disease have come from all departments of the company, and are more numerous in the generating stations. The men employed in the electrical construction, interior and aerial, are a particularly robust set of individuals, and are seldom ill.

In same instances the substations are in basements or sub-basements where the temperature ranges very high, in some cases considerably over 100° F., and the air is not strictly pure. These basements are not generating stations, but plants equipped with rotary converters, where the current is received at a high voltage and distributed to the consumers at about 110 volts. Close confinement in these basements, breathing impure air, and enervation by the intense heat has caused some of the men to break down, and we have found it necessary to give them work in the open air in order to bring them back to a normal condition of health.

The cases of tubercular disease in the generating plants are found largely among the machinists, and are probably helped along by the high temperatures and by particles of dust inhaled by the workmen. We have had two cases of tuberculosis in firemen, and the same conditions of heat and dust doubtless contributed to their physical breakdown.

Among the injuries sustained we have the usual fractures and dislocations of bones, wounds and contusions of all kinds, sprains, nail punctures, and other injuries such as are met with in men and women engaged in any hazardous occupation. Peculiar to the electrician are accidents such as burns, shocks, and infections from copper wire. We have had some very severe cases of infection from punctures or scratch by copper wire. This metal appears to be particularly poisonous when it penetrates the epithelium, and some virulent cases of cellulitis have resulted from mere abrasions received in striking the wire.

Shocks are common; severe shocks causing deaths are now rare in comparison to what they were 10 years ago, owing to the various safety devices, the greater care in supervision, and greater caution on the part of the employee. In the Chicago Telephone Co., in one year, there were 473 cases of shock reported, two of which resulted in death. In the Commonwealth Edison Co. no exact record has been kept. Of burns, we have all varieties—the steam burn, second degree; the burn by hot insulating compound, usually second degree; the flash burn from short-circuiting a wire, second degree. The dazzling arc formed by the short circuit nearly always affects the eyes, causing a severe conjunctivitis, which may not be felt until several hours after the burn on the hands or face has been received. Occasionally the cornea is burned.

The contact burn is received by the fingers or any part of the body touching a live wire, brass-bar switch, or any piece of metal charged with the electric current. The severity of the burn depends on the amount of current, or the length of time in contact, or whether the contact is perfect. A perfect contact with a good " ground " from a wire carrying anywhere from 350 volts upwards will often cause death. I believe that some men escape death on account of being in perfect physical condition, whereas some who may have some organic disease of the heart or kidneys will succumb to a much lighter voltage than that from which others escape.

The contact burn is sometimes very severe, resulting at times in the loss of one of the extremities. We have had two cases where amputation of the arm was necessary, one case of amputation of the leg, and many cases of amputation of fingers and the whole hand. The current, by its electrolytic action on the blood, causes a necrosis of the tissues and bones by destroying the blood supply to the parts where the current penetrates and where it makes its exit from the body.

The popular impression, shared with the laity by many physicians, that contact with the electric current causes paralysis and brain lesions is an entirely erroneous one. I have seen a hundred cases of shock, and, where the individual did not meet immediate death, there has never been one case in which the patient suffered in any way outside of the local effect of the burns, which may result in loss of a member or a bad scar. One man, whose head came in contact with live wire, received a burn, in the healing of which the outer table of the skull for a space of 2 inches long and one-half inch wide sloughed away, and he has been at work steadily for over two years, apparently in better condition than before his injury. In many instances we have had men receive severe shocks and burns who, after recovery, have put on weight and have appeared stronger physically than before the shock.

Women are more sensitive to the electric current than men, and girls working on telephone switchboards sometimes become quite hysterical after a slight shock from a low voltage.

DIE UNFÄLLE UND ERKRANKUNGEN DER EISENARBEITER.

Prof. Dr. FRIEDRICH RÖPKE in Solingen.

A. UNFÄLLE.

In wie hohem Grade die Eisenarbeiter Betriebsunfällen ausgesetzt sind, geht aus einer Zusammenstellung Saegers über das Jahr 1891 hervor: In diesem Jahre betrug die Zahl der Versicherten bei den 8 Deutschen Eisen- und Stahl-Berufsgenossenschaften 11.69 Prozent, 1/9 der bei sämtlichen 64 gewerblichen Berufsgenossenschaften Versicherten. Dagegen war der Prozentsatz der entschädigungspflichtigen Unfälle 16.16, 1/6, und der überhaupt angemeldeten Unfälle gar 24.9, oder 1/4.

Unter den Eisenarbeitern sind nun wieder die Arbeiter der Grosseisenindustrie (Hüttenbetriebe, Walz- und Hammerwerke), in viel höherem Grade Unfällen ausgesetzt, als die Arbeiter der Kleineisenindustrie. Auch sind die Unfälle bei den Arbeitern der ersten Gruppe durchschnittlich schwerer, wie ohne weiteres aus der Gegenüberstellung der auf Tabelle 1 befindlichen statistischen Angaben hervorgeht.

Die Unfälle der Eisenarbeiter bestehen zum grössten Teile in mechanischen Verletzungen, nur ein kleiner Bruchteil entsteht durch Verbrennung oder Verbrühung.

Wenn wir den Unfallsursachen in den einzelnen Betrieben näher nachgehen, so stossen wir bei den Hochofenarbeitern zunächst auf Explosionsverletzungen. Die Explosionen ereignen sich bei Eintritt von Luft in die Gasleitungen oder auch bei Berührung des flüssigen Eisens mit Wasser. Gelegenheit zu Verbrennungen bietet sich bei den Hochofenarbeitern auf der Gicht, vor der Abstichöffnung und beim Transportieren der glühenden Schlacken. Unfällen durch Gasvergiftung sind diese Arbeiter auf der Gicht, bei Undichtigkeiten oder bei Reinigungsarbeiten der Gasleitung ausgesetzt.

In den Eisengiessereien und Gussstahlwerken bestehen grosse Unfallgefahren beim Transportieren und Ausgiessen des flüssigen Metalls, wie auch beim Transportieren oder Verladen der fertigen Produkte. In Stahlwerken kommen bei dem Bessemer-Verfahren oft Verbrennungen durch Funkenregen aus den Convertern vor. Arbeiter an den Martinöfen sind Explosionsgefahren bei der In- und Ausserbetriebsetzung der Öfen ausgesetzt. In den Gussputzereien und Schleifereien können die Arbeiter durch abspringende glühende Metallteile beim Putzen an der Schmirgelscheibe oder beim Schleifen verletzt werden, auch kommen Unfälle durch Zerspringen von Schmirgel- oder Schleifsteinen vor. Walzwerkarbeiter laufen leicht Gefahr, von den austretenden glühenden Stäben gestreift oder gespiesst zu werden. Die Arbeiter in Hammerwerken erleiden oft Betriebsunfälle durch abspringende Metallteile, ab und zu auch durch unerwartetes Herabfallen des Hammerbären.

B. ERKRANKUNGEN.

ALLGEMEINE STATISTIK.

Dasselbe Bild, wie bei den Unfällen, haben wir wieder bei den Erkrankungen der Eisenarbeiter. Der Prozentsatz der Erkrankten ist bei den Arbeitern der Grosseisenindustrie erheblich grösser als in der Kleinesenindustrie. Zum Beweis dafür bringe ich die Morbiditätsstatistiken von je drei Werken der beiden Gruppen.

Auf 100 Arbeiter kamen Erkrankte in den Jahren 1903, 1904, und 1905:

GROSSEISENINDUSTRIE.

1. Deutsch-Österreichische Mannesmannröhrenwerke in Düsseldorf: 74.8, 81.7, 80.3.
2. Siegen-Solinger Gussstahlaktienverein in Solingen: 71.7, 59.2, 47.6.
3. Düsseldorfer Röhren- und Eisenwalzerke: 69.4, 84.4, 85.1.

KLEINEISENINDUSTRIE.

1. Firma I. A. Henckels in Solingen (Fabrik feiner Schneidewaren): 34.9, 40.6, 40.4.

2. Firma Weyersberg, Kirschbaum & Co. in Solingen (Fabrik für blanke Waffen und Fahrradteile): 33.8, 26.5, 30.2.

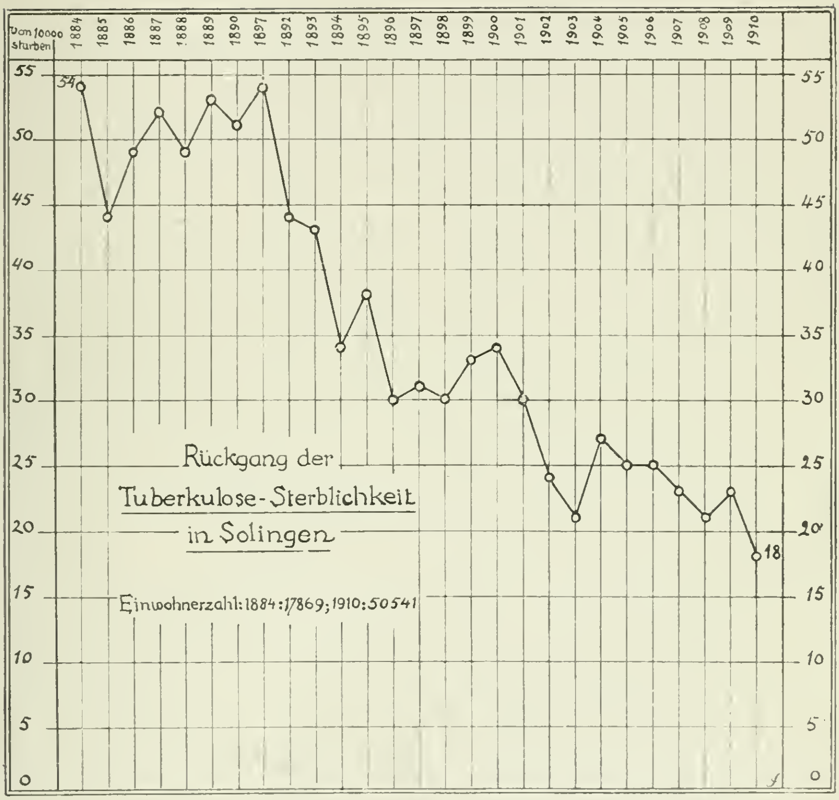
3. Firma Kortenbach & Rauh in Ohligs (Fabrik für Schirmfournituren): 22.6, 30.6, 30.9.

Unter den Arbeitern der Kleineisenindustrie nötigen uns nun ein ganz besonderes Interesse die Schleifer ab, deren Gesundheitsverhältnisse früher in allen Ländern trostlos waren. Über die Gesundheitsverhältnisse der französischen Schleifer sind mir keine neueren Untersuchungen bekannt. Da aber in Frankreich keine durchgreifende Sanierung der Arbeitsstätten stattgefunden hat, so gehen wir wohl nicht fehl, wenn wir annehmen, dass die Schleifer dort noch sehr ungünstige Gesundheitsverhältnisse aufweisen. Dass die Mortalität der amerikanischen Schleifer erschreckend gross ist, hat unter anderem James H. Lloyd im Jahre 1895 festgestellt. Die neuesten Untersuchungen über die Gesundheitsverhältnisse der englischen Metallschleifer hat der Medical Officer of Health für Sheffield, Dr. Scurfield angestellt. Nach ihm starben in den Jahren 1901–1909 von 1,000 lebenden Schleifern über 18 Jahre durchschnittlich jährlich 30.6, während von 1,000 Lebenden der ganzen männlichen Bevölkerung Sheffields über 20 Jahre in derselben Zeit nur 16.4 starben.

Der älteste deutsche Autor, der die Gesundheitsverhältnisse der Metallschleifer studiert hat, ist Oldendorff. Seine statistischen Erhebungen betreffen die Schleifer Solingens und erstrecken sich auf die Jahre 1850–1874. Die Mortalität der Schleifer über 20 Jahre betrug in dieser Zeit 25 pro Mille, während die Mortalität der übrigen männlichen Bevölkerung Solingens über 20 Jahre nur 12.6 pro Mille betrug.

Weitere Erhebungen über die Gesundheitsverhältnisse der Schleifer desselben Bezirkes verdanken wir Dönhoff. Seiner Statistik liegen die Sterbeziffern der Jahre 1885–1895 zu Grunde. Von 1,000 lebenden Schleifern starben 20.62, von 1,000 Lebenden der übrigen männlichen Bevölkerung Solingens nur 13.6 durchschnittlich jährlich. Auf die einzelnen Lebensalter verteilt ergab sich folgendes Resultat. Es starben von 1,000 Lebenden durchschnittlich im Alter von Jahren:

	14–20.	21–30.	31–40.	41–50.	Über 50.	Summa.
Schleifer	1.16	3.84	5.14	5.5	4.6	20.62
Übrige männliche Bevölkerung	1.0	1.5	1.7	2.5	7.1	13.6


Rückgang der
Tuberkulose-Sterblichkeit
in Solingen
Einwohnerzahl: 1884: 17869; 1910: 50541
Von 10000 starben
1884
1885
1886
1887
1888
1889
1890
1897
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
55
50
45
40
35
30
25
20
15
10
5
0
54
18

Im Jahre 1898 haben dann Moritz und ich weitere eingehende Untersuchungen über Morbidität und Mortalität der Solinger Schleifer gemacht: Wir fanden unter den 1,250 von uns untersuchten Vollständig Gesunde, 200, 16 Prozent; subjektiv Kranke, 71, 5.7 Prozent; objektiv Kranke, 979, 78.3 Prozent.

In der Altersstufe über 45 Jahre fand sich kein vollständig Gesunder mehr. Wesentlich günstiger boten sich die Verhältnisse schon in den Jahren 1904–5 dar: In diesen beiden Jahren starben von 1,000 lebenden Schleifern durchschnittlich 10.95. Von den über 20 Jahre alt verstorbenen Schleifern der Jahre 1904–5 standen im Alter bis zu 50 Jahren 76.51 Prozent, über 50 Jahre, 23.49 Prozent, gegen 81.9 Prozent und 18.1 Prozent der Oldendorff'schen Statistik aus den Jahren 1850–1874.

Im vorigen Jahre hat der Gewerbeinspektor in Solingen Dr. Kuhlmann für die Dresdner Internationale Hygiene-Ausstellung die Mortalität der Schleifer für die Jahre 1909–10 feststellen lassen; das Ergebnis war ein weiteres Sinken und zwar auf 9.3 pro Mille. (Vergleiche Tabelle 2 in der Anlage.)

Die Besserung der Gesundheitsverhältnisse der Solinger Schleifer drückt sich nun ferner in den folgenden Morbiditätsziffern aus: Bei der Ortskrankenkasse für Schleifer in Höhscheid bei Solingen erkrankten mit Arbeitsunfähigkeit 1886–1898 38.5 Prozent der Versicherten, dagegen 1902–1904 nur 22.6 Prozent.

AETIOLOGIE DER ERKRANKUNGEN.

A. GROSSEISENINDUSTRIE.

Als Berufsschädlichkeiten der Arbeiter der Grosseisenindustrie kommen hauptsächlich in Betracht:

(1) *Schädigungen, welche die Luftverunreinigung durch Gase, Dämpfe und Staub verursacht.*—Die Zusammensetzung und Menge der Gase ist nach den jeweiligen Bestandteilen der Eisenerze und nach dem Orte der Entstehung verschieden. Giftige Gase entweichen in den Hochöfenbetrieben aus der Gicht, aus dem Schlackenlauf und aus der Abstichöffnung. Sie haben einen hohen Prozentsatz an Kohlenoxyd, schwefliger Säure, Cyanverbindungen, und falls das Eisenerz bleiglanzhaltig ist, auch an Bleidämpfen.

In den Eisengiessereien und Gussstahlwerken sind die Schmelzer und Giesser durch die kohlenoxydhaltigen Gase der Oefen gefährdet, namentlich, wenn die Abzüge mangelhaft sind. Ferner atmen die Gasstocher grosse Mengen kohlenoxydhaltiger Gase ein. Die Former haben beim Formen selbst nur mit feinstem Material zu tun, dagegen leiden sie beim Einstäuben der fertigen Formen mit Kohlenpulver, Graphitstaub und dergl. und beim späteren Zerschlagen der noch heissen Formen unter Staub und Dämpfen. Hat der Former die Gussstücke von dem gröbsten Staub befreit, so kommen diese in die Hände des Gussputzers, der mit dem Meissel oder vermittelst des Sandstrahlgebläses die Putzarbeiten macht. Der feinere Putz wird vielfach auf trockenen Schmirgelsteinen hergestellt. Bei allen diesen Arbeiten wird Sand-, Metall- und Schmirgelstaub in reichlicher Menge aufgewirbelt.

(2) *Schädlichkeiten, welche durch die Schwere der Arbeit, durch häufigen jähen Temperaturwechsel, durch grelles Licht und durch die Fabrikgeräusche hervorgerufen werden.*—Die Arbeiten in der Hütten- und Grosseisenindustrie erfordern durchschnittlich ein grosses Mass von Körperkraft. Das Transportieren der Rohmaterialien, der halbfertigen und fertigen Produkte, das Hantieren mit den schweren Teilen während der verschiedenen Fabrikationsphasen bedingen eine ausserordentlich angestrengte Muskeltätigkeit. Die stets sich wiederholenden erheblichen Körperanstrengungen rufen naturgemäss leichtere oder schwerere Gesundheitsstörungen hervor. Während die Transportarbeiter ihre Beschäftigung sehr oft im Freien haben, dabei allerdings den Unbilden der Witterung ausgesetzt sind, leiden die eigentlichen Innenarbeiter noch mehr oder weniger unter der Gluthitze, welche den Oefen, dem flüssigen Metall oder den zu bearbeitenden glühenden Metallmassen entströmt. Setzen sich diese in Schweiss gebadeten Arbeiter Zugluft aus, oder treten sie unvermittelt, ohne den bei der Arbeit meistens nur halbbedeckten Körper bedeckt zu haben, an die frische Luft, so ziehen sie sich leicht Erkältungskrankheiten jeglicher Art zu. Ein weiterer, nicht zu unterschätzender Nachteil für die Gesundheit erwächst den Arbeitern aus der leider in der Mehrzahl dieser Betriebe nötigen Nachtarbeit. Die Arbeiter, welche in das grelle Licht der Oefen sehen müssen, erleiden ebenso wie die beim elektrischen Schweissverfahren beschäftigten Arbeiter Schädigungen seitens der Augen. Störungen des Gehörs treten auf die Dauer bei allen den Arbeitern auf, welche starken Fabrikgeräuschen ausgesetzt sind.

B. KLEINEISENINDUSTRIE.

Wir können bei der Kürze der zur Verfügung stehenden Zeit nur den Berufsschädigungen bei den folgenden vier Hauptgruppen nachgehen: 1. Schmiede; 2. Schlosser; 3. Feilenhauer; 4. Schleifer und Polierer.

1. *Schmiede.*—Sie haben unter dem Kohlenstaub und Kohlendunst des Schmiedefeuers zu leiden, namentlich, wenn die Werkstatt klein und schlecht ventiliert ist. Auch jähem Temperaturwechsel haben sie sich vielfach auszusetzen. Das lange Stehen und die durchschnittlich schweren Arbeitsverrichtungen bedingen häufig eine

Überanstrengung einzelner Muskelgruppen, sowie des ganzen Körpers.

2. *Schlosser.*—Bei den hauptsächlichsten Arbeitsverrichtungen dieser Gruppe, dem Zurichten, dem Feilen, dem Drehen, Bohren und Montieren des Arbeitsstücks wird so wenig Staub aufgewirbelt, dass nach dieser Richtung hin von Berufsschädigung kaum die Rede sein kann. Eine Ausnahme bilden die Arbeiten an der Schmirgelscheibe. Dagegen ist die vornübergebeugte Haltung, welche die Feiler und Dreher vielfach einnehmen, nachteilig für die Gesundheit. Die Schlosser haben auch in manchen Betrieben sehr unter den Fabrikgeräuschen zu leiden.

3. *Feilenhauer.*—Als gesundheitsschädigende Faktoren konmen in Betracht: Die Schwere der Arbeit, die Körperhaltung bei der Arbeit. Der Körper des Feilenhauers ist bei der Arbeit dicht über den Amboss gebeugt, sodass die Brust vollständig eingedrückt ist. Seine Arme sind in angestrengtester Tätigkeit, da er mit einem schweren Hammer schnell hintereinander Schläge gegen den auf die zu behauende Feile gesetzten Meissel auszuführen hat. Dagegen sind seine Füsse festgestellt, sie ziehen den Riemen an, durch den die Feile auf dem Amboss festgehalten wird.

4. *Schleifer und Polierer.*—Die hauptsächlichsten Gesundheitsschädlichkeiten sind (1) die Körperhaltung des Schleifers während der Arbeit; (2) der bei der Arbeit aufgewirbelte Stein- und Stahlstaub; (3) die Durchnässungen. Der deutsche Schleifer sitzt starkgebeugt auf einem Schemel, stemmt die Ellenbogen auf die Kniee und drückt mit vorgestreckter Hand den zu schleifenden Gegenstand gegen den Stein oder die Scheibe, welche auf ihn zu rotieren. Durch die gebückte Haltung, welche der Schleifer bei der Arbeit einnimmt, wird der Brustkorb zusammengedrückt. Der englische Schleifer hat eine Methode zu schleifen, welche nicht so gesundheitsschädlich ist. Er sitzt leicht gebeugt hinter und über dem Stein und presst mit ausgestreckten Armen den zu schleifenden Gegenstand gegen den Stein, der von ihm ab rotiert.

Arbeitet der deutsche Schleifer an trockenen Steinen, so fliegt ihm, da das Gesicht bei der oben beschriebenen Körperhaltung in unmittelbare Nähe des auf ihn zu rotierenden Steines kommt, eine reichliche Menge Sandstein- und Eisenstaub in Mund und Nase. Beim Pliessten und Polieren atmen die Schleifer ausser dem feinen Eisenstaub noch Schmirgelstaub, Staub der Poliermittel u. s. w. ein. Besonders gefährlich ist das Polieren mit Wiener Kalk auf Bürstenscheiben.

Bei der Arbeit an nassen Steinen ist die Staubentwicklung nicht besonders gross, da der meiste Staub gleich niedergeschlagen wird. Dafür wird der Nassschleifer aber durch das von dem rotierenden Stein abfliessende Wasser oft vollständig durchnässt. Die Schleifer setzen sich besonders häufig Erkältungen aus, weil sie vielfach die Gewohnheit haben, leicht bekleidet von ihrer erhitzenden Tätigkeit weg aus manchmal überheizten Räumen ins Freie zu gehen und sich dem Zuge auszusetzen.

SYMPTOME UND DIAGNOSE DER ERKRANKUNGEN.

(1) *Äussere Krankheiten.*—Bei den Hüttenarbeitern und Schmieden finden wir, infolge des Reizes, welchen der Staub und die strahlende Hitze auf die Haut ausüben, oft Ekzeme an den unbedeckten Körperteilen. Auch die Galvaniseure leiden durch die Berührung mit der Flüssigkeit des Bades nicht selten an chronischen Ekzemen der Hände und der Unterarme. Anlass zu Furunkelbildungen gibt der feine Kohlenstaub, der in Verbindung mit dem reichlichen Schweiss die Ausführungsgänge der Hautdrüsen bei den erstgenannten Arbeitern verstopft. Bei den Arbeitern, welche elektrisch schweissen, entstehen durch die starke Lichtentwicklung vielfach starke Hautreizungen. Zu der Rötung der Haut im Gesicht und an den Händen treten manchmal Blasenbildungen. Bei den Arbeitern tritt aber in der Regel eine Gewöhnung an die Bestrahlung ein.

Infolge des häufigen schroffen Temperaturwechsels erkranken die Hüttenarbeiter, die Schmiede und die Schleifer leicht an Rheumatismus, Ischias u. dergl.

Bei jugendlichen Arbeitern kommen durch das anhaltende Stehen bei der Arbeit und durch die professionelle Haltung leicht Deformitäten des Knochengerüstes zu stande. Bei Schlossern und Schmieden kommen Plattfüsse, bei Feilern und Schleifern Deformitäten des Brustkorbes und der Wirbelsäule auf diese Weise zu stande.

Die Hüttenarbeiter erleiden bei ihren schweren Arbeitsverrichtungen vielfach Muskelzerrungen und Zerreissungen am häufigsten in den Lendenmuskeln im Anschluss an das Aufheben schwerer Lasten.

(2) *Sinnesorgane.*—Bei den Feuerarbeitern entwickeln sich unter dem Einfluss des grellen Lichtes Bindehautkatarrhe und manchmal auch Linsentrübungen. Durch die intensive Lichtwirkung beim elektrischen Schweissverfahren kann die sogenannte "elektrische Ophthalmie" entstehen.

Anlass zu Bindehautkatarrhen bilden auch vielfach kleine Staubpartikelchen, die sich auf der Augenbindehaut ablagern. Durch die umhergeschleuderten Metall- und Schmirgelteilchen kommen ungemein häufig mehr oder weniger tiefgehende Verletzungen des Auges bei den Arbeitern in der Eisenindustrie vor.

Dass intensive Geräusche auf die Dauer eine zunehmende Schwerhörigkeit hervorrufen, ist eine allbekannte Tatsache. Nach den neuesten Forschungen seitens der Ohrenärzte, die durch mikroskopische Untersuchungen einzelner Schläfenbeine von Individuen, die an Geräuschtaubheit gelitten hatten, zum grössten Teil aber durch Tierexperimente gewonnen worden sind, handelt es sich bei dieser Geräuschtaubheit um eine Verkümmerung der Endausbreitungen des Hörnerven. In den Betrieben der Eisenindustrie entsteht nun beim Walzen, Schmieden und ·Putzen der zu bearbeitenden Eisen- und Stahlteile ein so intensives Geräusch, dass sich in diesen Arbeitsräumen selbst durch lautes Schreien nicht verständlich machen kann. Daher ist der Prozentsatz der Arbeiter, welche an Berufsschwerhörigkeit leiden, in diesen Betrieben auffallend gross.

(3) *Luftwege.*—Der massenhafte Staub, dem ein grosser Prozentsatz der Eisenarbeiter ausgesetzt ist, wirkt auf die Dauer krankmachend zunächst auf die Nasenschleimhäute. Die erste Wirkung des Staubes ist eine irritierende. Bei jugendlichen Arbeitern zeigt sich diese Reizwirkung in Form von Ausschlägen am Naseneingange, Rötung und Schwellung der Nasenschleimhaut, Erosionen und kleinen Ulzera an der Nasenscheidewand, deren Bildung dadurch begünstigtwird, dass die Betreffenden die Staubmassen mit den Fingern aus der Nase zu entfernen geneigt sind. Nach längerer Einwirkung des Staubes wird die Nasenschleimhaut oft atrophisch. In diesem Stadium klagen die Leute über Trockenheit, Verlegung der Nase und Herabsetzung des Riechvermögens. Der atrophische Prozess hat zur Folge, dass die Nase ihre normalen Funktionen verliert, und dem Staub Zutritt zu dem übrigen Respirationstraktus gibt. Das lästige Trockenheitsgefühl dehnt sich auf den Hals aus, auch Hustenreiz und Auswurf mit geringen Bluteimengungen stören das Wohlbefinden der Arbeiter. Dann bieten die Schleimhäute des Rachens, des Kehlkopfes und der Bronchien mutatis mutandis dasselbe Bild, wie die Schleimhäute der Nase: Am Rachendach und an der hinteren Rachenwand liegen teils frische, teils zu Borken eingetrocknenete Staubmassen, die darunter gelegene Schleimhaut ist auch hier vielfach atrophisch. Die atrophischen Schleimhäute sind sehr oft hypästhetisch. Man sieht bei der laryngoskopischen Untersuchung nicht selten auf den Stimmbändern und auf der Schleimhaut der hinteren Kehlkopfwand oder der subglottischen Partieen Staubmassen, ohne dass wesentlicher Hustenreiz besteht. Diese Hypästhesie des Respirationstraktus befördert naturgemäss das Eindringen von Staubteilen bis in die kleinsten Verästelungen der Luftröhre und in das Lungengewebe selbst.

Die Wirkung des Staubes auf das Lungengewebe ist nun kurz folgende: Der Staub ballt sich in den Alveolen, wo er teils frei, teils in Zellen eingebettet liegt. Diese Ballen bedingen zugleich mit den direkt in das peribronchiale und perialveoläre Gewebe sich bohrenden Staubteilchen Entzündungen bis zu Schwielenbildungen, und der

Zerfall dieser mit Staub gefüllten fibrösen Entzündungsprodukte und des von ihnen umschlossenen Gewebes führt endlich zur Zerstörung der Lungen.

Zu den Staubkrankheiten der Luftwege gesellt sich dann schliesslich in einem grossen Teil der Fälle die Lungentuberkulose, der dann die Arbeiter über kurz oder lang erliegen, wenn sie nicht in hygienisch günstigere Verhältnisse kommen. Nach Sommerfeld entfielen von 100 Todesfällen auf Krankheiten der Atmungsorgane bei den Formern 62.5, bei den Gussputzern 60, auf Lungenschwindsucht bei den Formern 41.7, bei den Putzern 35.7. Derselbe Autor stellte für Schmiede folgendes fest: Von den in der Berliner Ortskrankenkasse der Schmiede in der Zeit von 1885–1895 vorgekommenen Todesfällen waren 75 Prozent durch Krankheiten der Atmungsorgane und 66.6 Prozent durch Lungenschwindsucht bedingt. Einer ausführlichen Besprechung bedürfen auch hier wieder die Erkrankungen der Schleifer, welche ich an der Hand unserer, oben bereits erwähnten Untersuchungen schildern möchte: Unter den 1,250 untersuchten Schleifern waren 150, 12 Prozent brustkrank, und zwar litten 40, 3.24 Prozent, an Emphysem, 17, 1.36 Prozent, hatten Reste von Pleuritis und 113, 9.04 Prozent, der Gesamtheit litten an chronischen Katarrhen der Luftröhre oder der Lunge. Von den mit Katarrhen behafteten litten 26 an chronischen Reizzuständen (Katarrh 1), 83 an Infiltrationen oder Indurationen der Lunge (Katarrh 2), und 4 an Zerstörungen der Lunge (Katarrh 3). Die leichten Katarrhe, welche wir mit Katarrh 1 bezeichneten sind ebenso wie im oberen Respirationstraktus als Reizzustände aufzufassen. Durch die Staubeinwirkung kommt es zu anfangs trockenem, später feuchtem Husten mit schleimigem, schleimig-eitrigem, staubigem, selbst blutig tingiertem Auswurf. Die Schleifer gewöhnen sich allmählig an den Staub, es tritt also bei ihnen, wie wir das bei der Besprechung der oberen Luftwege ausgeführt haben, eine Hypästhesie des Respirationstraktus ein. Diese Hypästhesie befördert nun sicher das Eindringen von Staubteilen in die tieferen Gewebe. Das Eindringen und Ansammeln des Staubes in der Tiefe wird ferner durch alle diejenigen Hilfursachen befördert, welche den Zutritt zu den tieferen Particen begünstigen und welche das Wiederauswerfen erschweren. In erster Linie werden die mehr staubliefernden Arbeiten die Lunge stärker und eher gefährden. Die Schleifer welche nur trocken arbeiten, sind dementsprechend mehr gefährdet als die, welche trocken und nass schleifen. Wir fanden unter den Trockenschleifern 13.7 Prozent Lungenkranke und unter den Schleifern, welche trocken und nass schleifen, nur 11.3 Prozent. Ferner wird die gebückte Haltung welche die Schleifer bei der Arbeit einnehmen, ihren Thorax komprimieren, die Entfaltung der Lunge bei der Inspiration beschränken und so dem Staube Gelegenheit geben, sich in den nicht entfalteten Partieen festzusetzen. Endlich werden die häufigen Erkältungen, denen sich die Schleifer aussetzen, soweit diese akute Bronchitiden, Pneumonien und Pleuritiden im Gefolge haben, die Widerstandsfähigkeit des Gewebes herabsetzen.

Bei den mit Infiltrationen oder Indurationen einhergehenden Katarrhen (Katarrh 2) kann man alle nur denkbaren auskultatorischen Phänomene beobachten, diffus oder umschrieben. An der Spitze befindet sich gewöhnlich die Dämpfung. Man findet in diesem Stadium ein stark eitriges, mehr oder weniger stark gefärbtes Sputum. Die beim Katarrh 3, dem letzten Stadium, oft auftretenden grösseren Blutungen sind auf Zerstörungsvorgänge zurückzuführen und dürfen mit den im Anfangsstadium dem Sputum zuweilen beigemengten Blutstreifen nicht verwechselt werden.

Wie wir oben schon auseinander gesetzt haben, ist die Tuberkulose eine rein accidentelle Erkrankung. Die mit Zerstörungen der Lunge (Katarrh 3) behafteten Schleifer sind aber sicher alle tuberkulös. Auch von den mit Katarrh 2 Behafteten ist ein grosser Prozentsatz tuberkulös, und bis in die Zahl der an Katarrh 1 Erkrankten wird sich die tuberkulöse Infektion sicherlich erstrecken.

Diesen Schilderungen entsprechend ist denn auch die Zahl der an Lungenerkrankungen zu grunde gehenden Schleifer von jeher in allen Ländern hoch gewesen. Über die Mortalitätsverhältnisse der amerikanischen Schleifer liegen nur ganz spärliche Berichte vor. Hoffman bringt in einer von dem Department of Commerce and Labor im Jahre 1908 herausgegebenen Arbeit folgende Zahlen: Bei einer gewerkschaftlichen Versicherungsgesellschaft waren unter 128 Todesfällen von Schleifern 63, oder 49.2 Prozent, durch Lungenschwindsucht herbeigeführt (Gesamte männliche Bevölkerung der Vereinigten Staaten über 15 Jahre, 14.8 Prozent), 15 durch Pneumonie, 5 durch Asthma und Bronchitis und 2 durch andere Erkrankungen der Luftwege. Insgesamt waren also 85, oder 66.4 Prozent, der Todesfälle bei den Schleifern durch Erkrankungen der Luftwege herbeigeführt. Die schon oben erwähnte Statistik des Dr. Scurfield berichtet über die Sheffielder Schleifer folgendes: In den Jahren 1901–1909 starben von tausend lebenden Schleifern 30.4, darunter 15.1 an Phthisis und 5.4 an anderen Erkrankungen der Luftwege, die entsprechenden Zahlen waren (1); für die sonstigen Arbeiter der Stahlwarenindustrie 29.3, 5.8, 6.9, and (2) für die gesamte über 20 Jahre alte männliche Bevölkerung Sheffields 16.6, 2.7, und 3.4. Günstig sieht es neuerdings in dem Hauptzentrum der deutschen Kleineisenindustrie, in Solingen aus. In den Jahren 1885 bis 1895 starben durchschnittlich von 1,000 lebenden Schleifern noch 12.82 an chronischen Erkrankungen der Atmungsorgane, in den Jahren 1904–1905 nur noch 7.82 und 1909–1910 war die Zahl auf 6.72

(4.37 an Tuberkulose und 2.35 an anderen Erkrankungen der Luftwege) heruntergegangen. Aber auch hier war die Sterblichkeit der Schleifer an Erkrankungen der Luftwege doch noch wesentlich höher als die der übrigen Stahlwarenarbeiter, bei denen von 1,000 Lebenden nur 4.43 (2.66 an Tuberkulose und 1.79 an anderen Erkrankungen der Atmungsorgane) in den Jahren 1909–1910 starben.

(4) *Vergiftungen.*—Den Hüttenarbeitern kann dass Kohlenoxydgas gefährlich werden: Durch Einatmung dieses Gases kommen akute Vergiftungen des menschlichen Organismus zu stande, die falls der Tod nicht eintritt, schwere Krankheitserscheinungen machen. Werden kleinere Mengen Kohlenoxydgas dauernd eingeatmet, so können chronische Vergiftungen eintreten. Unter Berücksichtigung der Anamnese ist die Diagnose der akuten Kohlenoxydgasvergiftungen meistens leicht zu stellen. Schwieriger ist die Diagnose der chronischen Vergiftung; in sehr vielen Fällen werden wir uns hier mit einer Wahrscheinlichkeitsdiagnose begnügen müssen.

Bei Feilenhauern kommt infolge der Bleistaubeinatmung und der ständigen Berührung mit Blei nicht selten Bleivergiftungen vor. Nach Sprenger erkrankten in Berlin von den mit Bleiunterlage arbeitenden Feilenhauern durchschnittlich jährlich 5.24 an Bleivergiftung.

Bei Feuervergoldern in der Schwertindustrie habe ich einige male Quecksilbervergiftung gesehen.

PROPHYLAXE.

Bei der Beurteilung der Morbidität und Mortalität der Industriearbeiter bleibt zu berücksichtigen, dass ihre Höhe abhängig ist einmal von der Widerstandskraft des Einzelnen und sodann von der Summe der auf ihn einwirkenden Schädlichkeitsmomente. Eine Abnahme der Erkrankungshäufigkeit und der Sterblichkeit kann mithin sowohl durch eine Hebung der Widerstandskraft des Einzelnen, wie durch eine Einschränkung der Schädlichkeitsmomente bewirkt werden. Wenn wir prophylaktische Massnahmen treffen wollen, so haben wir also nach dem eben gesagten ausser den Berufsschädlichkeiten u. a. noch zu berücksichtigen: Die Wohnungsverhältnisse, die Lebens- und Ernährungsweise und die wirtschaftliche Lage der Arbeiter. Damit stehen wir mitten in dem schwierigen Gebiete der Volkswirtschaftslehre. Fragen wir zunächst einmal, wer denn ausser dem einzelnen Arbeiter selbst Interesse an einem gesunden Arbeiterstande hat. Die ideellen Gesichtspunkte sollen dabei vollständig aus dem Spiele gelassen werden. Die Interessenten sind dann (1) der Staat. (2) die Kommunen. (3) die Arbeitgeber. Für den Staat und die Kommunen fallen die hohen Verluste an Menschenleben und Gesundheit in den jüngeren und Mittleren Lebensaltern wirtschaftlich ganz besonders schwer ins Gewicht.

Die Wehrkraft des Staates wird dadurch herabgesetzt, wenn der Industriearbeiter infolge der verschiedenen gesundheitsschädigenden Faktoren zur Zeit der Aushebung zum Militär schon so weit entartet ist, dass er der Militärpflicht nicht genügen kann. Sodann büssen Staat und Kommunen durch jeden Kranken oder vorzeitig sterbenden Arbeiter an Steuerkraft ein. Ferner werden die Armenlasten der Gemeinden durch jeden kranken oder vorzeitig verstorbenen Arbeiter, sofern er Familienhaupt war, in die Höhe getrieben. Die Arbeitgeber schliesslich wissen recht gut, dass die gesunden Arbeiter die billigsten Arbeitskräfte sind.

Was können nun die genannten Interessenten zur Hebung der Gesundheit der Industriearbeiter tun?

Der Staat hat die vornehme Pflicht, das Leben und die Gesundheit der Industriearbeiter durch eine geeignete Gesetzgebung zu schützen. Die Fabrikgesetzgebung muss darauf Bedacht nehmen, die Arbeitszeit in den Betrieben im allgemeinen zu regeln, im besonderen muss die ungemein aufreibende und nervenzerrüttende Nachtarbeit und die Arbeit der körperlich und sittlich in höherem Grade gefährdeten Frauen und Kinder geregelt werden.

Ferner gehört es zu den Obliegenheiten des Staates, für die bestmögliche Sanierung der Arbeitsstätten zu sorgen. Zu den sozialen Pflichten eines modernen Staates gehört auch die Arbeiterversicherungsgesetzgebung. Es sei nur noch kurz darauf hingewiesen, dass der Staat auch das Recht und die Pflicht hat, die Arbeitszeit in besonders gesundheitsgefährlichen Betrieben herabzusetzen. Es ist ja ohne weiteres verständlich, dass die Gesundheitsschädigungen um so mehr einwirken, je länger die Arbeitszeit ist.

Auch die Gemeinden können dazu beitragen, dass den Industriearbeitern das kostbare Gut der Gesundheit möglichst gewahrt bleibt. In erster Linie hat die Gemeindeverwaltung dafür zu sorgen, dass die Arbeiterwohnungen hygienisch einwandfrei sind. Denn wie ich schon oben anführte, kommt zu den Schädlichkeiten, welche die Berufstätigkeit des Fabrikarbeiters mit sich bringt, als konkurrierende Schädlichkeit eine unzweckmässige Wohnung hinzu. Die Gemeinden können hier helfend eingreifen durch alle Massnahmen, welche die Verbesserung und Ergänzung der Bauordnung, die Änderung der Bauweise für Wohngebäude u. s. w. zum Ziele haben. Ein alter hygienischer Lehrsatz besagt: Die Häufigkeit der Tuberkulose nimmt mit der Wohnungsdichtigkeit zu. Je dichter die Bevölkerung einer Gegend ist, um so mehr ist mithin seitens der Gemeinden inbezug auf öffentliche Gesundheitspflege zu tun. So haben die grösseren Gemeinwesen für gute Krankenhäuser, öffentliche Plätze und Anlagen, Kanalisation u. s. w. zu sorgen.

Eine grosse Verantwortung inbezug auf die Gesunderhaltung der Fabrikarbeiter hat nun ferner der dritte Interessent, der Arbeitgeber. Von seiner mehr oder weniger ausgeprägten sozialen Denkungsweise hängt in mancher Beziehung das Wohl und Wehe der Arbeiterschaar seines Betriebes ab. Was kann ein wohlwollender Arbeitgeber nicht alles zur Hebung der Gesundheitsverhältnisse seiner Arbeiter tun, wozu er gesetzlich nicht verpflichtet ist?

Alle die Interessenten können nun schliesslich, jeder an seinem Teile, durch Wort und Schrift, durch belehrende Vorträge, durch die Presse und durch populäre Broschüren dazu beitragen, dass die Arbeiter mit den Grundzügen der Hygiene vertraut gemacht werden; denn je mehr das Volk in diesen Fragen aufgeklärt wird, um so mehr Selbstzucht wird es üben lernen. Im besonderen sind die Arbeiter immer wieder auf die gesundheitlichen Gefahren ihres jeweiligen Berufes aufmerksam zu machen, auch sind ihnen Belehrungen zu geben, wie sie sich ihren Körper gesund erhalten können. Von eminenter Wichtigkeit ist eine vernünftige Körperpflege. In den Betrieben müssen Wasch- und Badeeinrichtungen vorhanden sein, damit die Arbeiter, nachdem sie ihre Fabrikkleider abgelegt haben, auch den mit Staub und Schweiss bedeckten Körper gründlich säubern können. Die Arbeitskleider sind in einem dafür hergerichteten Raume am besten so aufzubewahren, dass sie in der Zwischenzeit gründlich auslüften. Die Kleidung bei der Arbeit muss zweckmässig sein, sie soll der Beschäftigung entsprechen. Die in den Fabrikräumen oft herrschende Hitze, kann in etwa durch Ventilation gemildert werden. Die Arbeiter sind zur Mässigkeit im Genusse alkoholischer Getränke anzuhalten, gesundes Trinkwasser ist an möglichst vielen Stellen des Betriebes bereitzustellen, auch sollten andere durststillende alkoholfreie Getränke in den Fabriken zu billigen Preisen zu haben sein.

Von allergrösster Wichtigkeit für das Leben und die Gesundheit der Arbeiter sind alle Schutzmassnahmen, welche gegen die schädigenden Einwirkungen des Staubes, der Gase und Dämpfe getroffen werden. Als erster Grundsatz gilt hierbei: Der Staub oder die Gase müssen am Orte ihrer Entstehung resp. ihres Austrittes in die Arbeitsräume unschädlich gemacht werden. Was die Gase betrifft, so werden die Hochofengase in Deutschland jetzt in den meisten Betrieben abgeleitet, um zum Betriebe von Gaskraftmaschinen oder zu Beleuchtungszwecken verwandt zu werden. Sonst werden sie auch vielfach zum Vorwärmen der Gebläseluft, oder zum Heizen des Kessels benutzt. Die Gefährlichkeit der Gase in den Giessereien kann durch zweckmässig angelegte natürliche oder künstliche Ventilation auf ein Minimum reduziert werden. Bei den früher so gefürchteten Arbeiten des Reinigens und Reparierens der Gasleitungen kann man die Arbeiter durch Rauchmasken, Respiratoren, Mundschwämme u. s. w.

vor Gasvergiftungen schützen. Noch besser ist es, wenn die Gasleitungen so angelegt sind, dass sie möglichst von aussen zu reinigen sind. Wie wir oben ausgeführt haben, wird bei den Gussputzarbeiten sehr viel Staub entwickelt. Sind die Putztische oder die Schmirgelscheiben an eine Staubabsaugevorrichtung angeschlossen, so wird die Staubmenge, welche in die Arbeitsräume kommt, bedeutend verringert. Ein grosser Fortschritt ist es auch, wenn vermittelst des Sandstrahlgebläses unter gleichzeitiger Staubabsaugung geputzt wird.

In den Schmiedewerkstätten müssen Vorkehrungen getroffen werden, welche die Arbeiter vor der ausstrahlenden Hitze des Schmiedefeuers schützen, ferner müssen die Essen mit einem guten Abzuge versehen sein. Zur Besserung der Gesundheit der Schmiede trägt auch viel eine gute Körperpflege bei.

Die Gesundheitsverhältnisse der Feilenhauer können erheblich dadurch verbessert werden, dass anstatt der noch vielfach üblichen Bleiunterlage eine solche aus Zinn allgemein eingeführt wird, was nach Sachverständigenurteil ohne Nachteil für die Qualität der Ware geschehen kann. Ferner liesse sich die gesundheitsschädliche Körperhaltung der Feilenhauer bei der Arbeit in etwa dadurch korrigieren, das sowohl Arbeitschemel wie Amboss mit einer Vorrichtung zum Verstellen versehen würden. In den Metallschleifereien muss die Staubentwickelung möglichst verhindert und ihre Beseitigung energisch angestrebt werden. Zur Verhinderung der Staubentwickelung ist es geboten, nass zu schleifen wo es irgendwie möglich ist. Zur Beseitigung des Staubes am Ort der Entstehung dienen Absaugeeinrichtungen, auf deren möglichste technische Vervollkommnung hingearbeitet werden muss. Für den Regierungsbezirk Düsseldorf existiert eine strenge Polizeiverordnung über die Einrichtung und den Betrieb der Metallschleifereien, die ich in Anlage 1 zum Abdruck bringe. Auch für Sheffield sind ähnliche gesetzliche Verordnungen im Gange. Da selbst durch die vollkommensten Staubabsaugevorrichtungen das Eindringen des Staubes in den Schleifraum nicht ganz und gar wird verhindert werden können, so ist dafür Sorge zu tragen, dass der sich in den Schleifstuben und auf den Geräten ablagernde Staub möglichst oft und gründlich entfernt wird.

Für den Bezirk Solingen sind auch gesundheitliche Ratschläge für die Schleifer ausgearbeitet worden, die von den Behörden den Schleifern zur Beachtung empfohlen worden sind (vergl. Anlage 2). Durch alle diese Massnahmen ist im Solinger Bezirk im Laufe der Jahre eine bedeutende Besserung der Gesundheitsverhältnisse der Schleifer erzielt worden, die in dem andauernden Sinken der Mortalitätsziffer für die Schleifer zum Ausdruck kommt.

ANLAGE 1.

Polizeiverodnung betreffend die Einrichtung und den Betrieb der Metallschleifereien mit der Gültigkeit vom 1. November 1899 für den Regierungsbezirk Düsseldorf.

§ 1. Anlagen mit elementarer Kraft, in denen Metallwaren geschliffen, gepliesstet, poliert oder Scheiben geputzt werden, müssen geräumig und hoch sein, und ausreichende, zum Öffnen geeignete Fensterflächen besitzen.

Bei der Neuanlage oder Erweiterung einer Schleiferei muss in jedem Arbeitsraume die lichte Höhe mindestens 3.5 m, die zu öffnende Fensterfläche mindestens $\frac{1}{12}$ der Fussbodenfläche betragen und es muss für jede beschäftigte Person ein Mindestluftraum von 16 cbm vorhanden sein.

§ 2. Die Fussböden müssen fest und dicht sein, die Wände sind jährlich mindestens einmal frisch anzustreichen, zu kälken oder gründlich abzuwaschen.

Bei der Neuanlage oder Erweiterung einer Trockenschleiferei ist die Herstellung von Fussböden aus Lehm verboten.

§ 3. Die Fussböden und die nichtverdeckten, dem Staub ausgesetzten Triebwerke und Gerätschaften sind wöchentlich wenigstens einmal gründlich von Staub zu reinigen, dabei die Fussböden feucht aufzuwischen.

Die Schleifer haben ihre Arbeitsplätze jeden Abend staubfrei herzurichten.

§ 4. Die zum Trockenschleifen dienenden Steine und zum Bürsten und zum Trockengrobpliessten dienenden Scheiben, sowie diejenigen Polierscheiben und Vorrichtungen, an denen mit Wiener Kalk oder ähnlichen Staub verursachenden Poliermitteln gearbeitet wird, sind mit einer Staubsaugevorrichtung zu versehen, welche den vom Regierungspräsidenten erlassenen Vorschriften entspricht.

§ 5. Die Umhüllungskästen und die Rohre der Absaugevorrichtung müssen in allen Teilen sorgfältig gedichtet sein. Scharfe Richtungs- und Querschnittsveränderungen in der Rohrleitung sind zu vermeiden.

Der Umhüllungskasten darf nur soweit offen sein, wie es die Arbeit unbedingt erfordert. Die Rohrleitung ist so einzurichten, dass sie ohne Schwierigkeit gereinigt werden kann.

§ 6. Bei der Neuanlage oder Erweiterung einer Schleiferei ist die Absaugevorrichtung unter oder in den Fussboden zu legen. Die Hauptsaugerohre müssen derart gelagert werden, dass sie ein gleichmässiges Gefälle nach dem Luftsauger (ventilator, exhauster) haben.

§ 7. Es ist dafür Sorge zu tragen, dass die Staubsaugevorrichtungen den stehenden Bestimmungen entsprechend während der Arbeit stets in Betrieb gesetzt und in Ordnungs mässigem Zustande erhalten werden.

§ 8. Das Abdrehen der Steine darf vor Schluss der Tagesarbeitszeit nur vorgenommen werden, wenn es entweder unter Zuführung von Wasser ohne Stauberzeugung geschieht, oder wenn ein Kasten vorhanden ist, in welchem der Stein, abgesehen von der Arbeitsstelle des Abdrehmeissels, völlig eingeschlossen, und welcher an eine kräftig wirkende Absaugevorrichtung derart angeschlossen wird, dass kein Staub in den Arbeitsraum gelangen kann.

Auf das tägliche Schleifen der Steine findet diese Vorschrift keine Anwendung.

§ 9. Der Schleifstaub muss ausserhalb der Arbeitsräume zweckentsprechend aufgefangen oder derart ins Freie geleitet werden, dass er nicht wieder in den Arbeitsraum gelangen kann. Auch muss eine Belästigung der Nachbarschaft durch Staub und unnötiges Geräusch des Luftsaugers ausgeschlossen sein.

§ 10. Sämtliche zum Schleifen der Messer, der Scheren und der Sägen, zum Nassschleifen der Schwerter, zum Trockenschleifen der Zangen und Beitel dienenden Steine, sowie sämtliche Schmirgelsteine müssen, sofern es nach der Art der zu verrichtenden Arbeit möglich ist, mit stets in gutem Anstrich erhaltenen Schutzböcken versehen sein, welche je nach dem fortschreitendem Verschleiss der Steine verstellbar, genügend stark und durchaus sicher verankert oder befestigt sind, sodass bei einem Zerspringen der Steine ein Fortfliegen der Sprungstücke verhindert wird. Für den Fall, dass die Neubeschaffung der Schutzböcke in einer bereits bestehenden Schleiferei mit erheblichen Kosten verbunden ist, kann die Polizeibehörde auf Antrag für die Anbringung der Schutzböcke eine Frist bis spätestens zum 1. Januar 1901 gewähren.

Der Regierungspräsident kann Ausnahmen, auch abgesehen von letzterem Falle und über die gedachte Frist hinaus zulassen. Ausnahmen dürfen jedoch nicht zugelassen werden, wenn es sich um Steine handelt, welche nach den Unfallverhütungsvorschriften der Berufsgenossenschaft schon jetzt mit Schutzböcken versehen sein müssen.

§ 11. Die Krafterzeuger, mit Ausnahme der Wasserräder, müssen mit sicher wirkenden Regulatoren versehen sein, welche ein Durchgehen des Krafterzeugers verhindern.

§ 12. Der Genuss von Branntwein in den Arbeitsräumen und deren Vorräumen während der regelmässigen Arbeitszeit ist verboten.

Betrunkene dürfen sich in den genannten Räumen nicht aufhalten.

Anlage 2.

GESUNDHEITLICHE RATSCHLÄGE FÜR SCHLEIFER IM STADT- UND LANDKREIS SOLINGEN.

Der Beruf des Schleifers gilt mir Recht für besonders gesundheitsschädlich. Die durchschnittliche Lebensdauer der Schleifer ist wesentlich kürzer als die anderer Bevölkerungsklassen. Es kann daher den Schleifern sowie den Eltern welche für ihre Kinder einen Beruf zu wählen haben, nur dringend empfohlen werden, zur Vermeidung der Gesundheitsschädigungen und ihrer Folgen nachstehende Ratschläge sorgfältig zu beachten:

I. Am ersten erkranken natürlich die Schleifer, die schon als Kinder wenig widerstandsfähig gewesen sind. Es ist daher Pflicht der Eltern und der Schleifermeister, darauf zu sehen, dass nur gesunde, kräftige Knaben das Schleifen lernen.

Schwächliche, kränkelnde Knaben sind auszuschliessen, insbesondere solche, die aus kranken Familien stammen, die selbst schon Erkrankungen der Lungen durchgemacht, die starke Drüsenschwellungen, Nasenerkrankungen und Hautausschläge haben oder zu Husten und Rheumatismus neigen.

Wünschenswert wäre es, wenn die Eltern Knaben, die Schleifer werden wollen, vor Eintritt in die Lehre ärztlich untersuchen lassen, wenigstens dann, wenn Zweifel über die Tauglichkeit bestehen.

II. Wie erhält sich nun der Schleifer seinen Körper gesund?

1. Der Hauptfeind des Schleifers ist der Staub, der bei der Arbeit erzeugt wird. Über Absaugung des Staubes, Reinigung der Schleifstellen u. s. w. gibt es polizeiliche Verordnungen. Es kann den Schleifern nicht dringend genug ans Herz gelegt werden, diese Vorschläge im Interesse der eigenen Gesundheit sehr ernst zu nehmen.

Ausserdem soll der Schleifer aber auch auf folgende Punkte achten:

2. Während der Arbeit soll er stets durch die Nase atmen; in der Nase wird die Luft filtriert und erwärmt. Atmet man durch den Mund, so kommt die nicht von Staub gereinigte Luft direkt in den Hals und in die Luftröhre und erzeugt dort Reizzustände, die auf die Dauer zu Erkrankungen der Luftwege führen müssen (Schleiferkrankheiten u. s. w.).

3. Eine möglichst gerade Körperhaltung bei der Arbeit ist anzustreben, weil nur bei dieser Haltung die Lungen wirklich ausgiebig atmen und sich in allen Teilen genügend ausdehnen können. Wenn bei langer Arbeit der Rücken lahm wird, so muss man sich zeitweise strecken.

Um die Angewöhnung an krummes Sitzen zu verhüten, tun die Meister gut, von vornherein bei den Lehrlingen auf gutes Sitzen bei der Arbeit zu achten.

4. Durchnässungen durch Schleifwasser können auf die Dauer leicht zu Erkältungen (Katarrhen und Rheumatismen) führen und müssen deswegen durch geeignete Kleidung, Schurz u. s. w. verhütet werden.

5. In der Frühstücks- und Vesperpause tut der Schleifer gut, den Arbeitsraum zu verlassen und wenn möglich in einem staub- und zugfreien Raum oder im Freien seine Mahlzeit einzunehmen. Während der Pausen sind die Schleifräume durch Öffnen der Fenster gründlich zu lüften.

Die Mittagsmahlzeit wird zweckmässig zu Hause eingenommen, weil sie auf diese Weise zu einem kurzen Spaziergang zwingt.

Bei jedem Verlassen des Arbeitsraumes muss natürlich der Rock zur Verhütung von Erkältungen angezogen werden.

6. Die Temperatur in den Schleifräumen soll möglichst gleichmässig und nicht zu warm sein (14° R.). Es empfiehlt sich falls die Luft in den Schleifräumen zu trocken wird, in ihnen Wasser verdunsten zu lassen.

7. Ausserdem ist möglichst dafür Sorge zu tragen, dass der Körper gegen die erwähnten Schädlichkeiten gestählt wird: Solides Leben, besonders Mässigkeit im Genuss von alkoholischen Getränken, Reinhalten des Körpers (Bad oder Abwaschungen), Lüften des Wohn- und besonders des Schlafzimmers, Benutzen jeglicher Gelegenheit zum Aufenthalt im Freien (Sonntagsspaziergänge) sind die hierfür geeigneten Mittel.

Stellen sich trotz aller Vorsicht Erscheinungen ein, die auf eingetretene oder bevorstehende Erkrankung deuten, so ist sofort ärztliche Hilfe in Anspruch zu nehmen.

Handelt es sich um Berufserkrankungen, so wird auf die besonders herausgegebenen " Ratschläge für Lungenkranke " Bezug genommen. Ihre Beschaffung ist den Krankenkassen empfohlen worden.

I. *Rhein. Hütten- u. Walzwerks- Berufsgenossenschaft.*

	Zahl der Versicherten.	Zahl der versicherungspflichtigen Unfälle.				Auf 1,000 Arbeiter kommen entschädigungspflichtige Unfälle.	Zahl der angemeldeten Unfälle.	Auf 1,000 Arbeiter kommen angemeldete Unfälle.
		Tod.	Dauernde Erwerbsunfähigkeit.		Vorübergehende Erwerbsunfähigkeit.			
			Teilweise.	Völlige.				
1907:								
Anzahl	171,672	220	1,930	154	444	16.1	30,260	176
Prozent		8.03	70.49	5.62	16.21			
1908:								
Anzahl	165,368	199	1.905	158	478	16.5	28,492	172
Prozent		7.25	69.32	5.79	17.47			
1909:								
Anzahl	165.470	183	1,630	198	513	15.2	27,895	169
Prozent		7.33	64.97	7.84	20.31			

II. *Rhein. Maschinenbau- u. Kleineisenindustrie Berufsgenossenschaft.*

1907:								
Anzahl	227,091	124	1,862	24	309	10.21	16,826	71.09
Prozent		5.38	80.29	1.03	13.33			
1908:								
Anzahl	223,330	117	1,871	27	358	10.63	15,631	69.99
Prozent		4.97	78.84	1.13	15.08			
1909:								
Anzahl	221,258	87	1,655	19	348	9.53	15,362	69.13
Prozent		4.12	78.47	0.90	16.50			

Von 1,000 Arbeitern der Stahlwaren-industrie starben im Jahresdurchschnitt—

Sterblichkeitstabelle.

	In Solingen (Krankenkassenstatistik), 1909–1910.[1]			In Sheffield (Dept. of the Medical Officer of Health), 1901-1909.[2]		
	Insgesamt.	An Tuberkulose.	An andere Erkrankungen der Atmungs-Organe.	Insgesamt.	An Tuberkulose.	An andere Erkrankungen der Atmungs-Organe.
Schleifer, Pliester, Polierer und Ausmacher (Grinding)	9.30	4.37	2.35	30.40	15.10	5.40
Sonstige Arbeiter der Stahlwaren-Industrie (Cutlery)	9.00	2.66	1.79	29.30	5.80	6.90

[1] Die Erhebungen erstrecken sich auf: 7,908 Schleifer und 10,872 sonstige Stahlwarenarbeiter.

[2] Die Erhebungen erstrecken sich auf: 3,941 Schleifer und 3,889 sonstige Stahlwarenarbeiter.

Von 1,000 Schleifern starben jährlich: 1885–1895, durchschnittlich 20.62; 1904–1905, durchschnittlich 10.95; 1909–1910, durchschnittlich 9.30.

ACCIDENTS PAR ÉLECTROCUTION.

Mesures préventives.—Secours à donner aux victimes.

M. Paul Weiss, Chief Mining Engineer of Paris, Ministry of Public Works, Paris, France.

L'administration française des Travaux Publics s'est dupuis longtemps, et bien avant le développement pris ces dernières années par l'industrie électrique, préoccupée de donner aux agents des services publics les instructions utiles pour remédier aux accidents par électrocution. Dès 1895 une circulaire ministérielle indiquait aux services locaux les principales règles à suivre: mesures techniques en vue de porter secours à la victime d'un accident, tout en protégeant les sauveteurs; mesures médicales conseillées en vue de limiter dans toute la mesure du possible, en attendant l'arrivée du médecin, les conséquences de l'accident.

Mais il n'est intervenu, en France, de réglementation complète en matière électrique qu'à la suite du vote par le Parlement de la loi du 15 juin 1906 sur les distributions d'énergie.

Un des principaux règlements issus de cette loi, l'arrêté ministériel du 21 mars 1908, déterminant les conditions techniques auxquelles doivent satisfaire les distributions d'énergie électrique, assure d'une manière générale la sécurité des installations. Afin de se tenir constamment au niveau des progrès de la science, cet arrêté technique est révisable chaque année, après avoir été étudié et préparé par un comité permanent d'électricité siégeant au Ministère des Travaux Publics, et composé par moitié des ingénieurs de l'État, par moitié des représentants des principales entreprises industrielles d'électricité en France.

Les ingénieurs des services locaux de contrôle demeurent d'ailleurs libres, aux termes mêmes de l'arrêté technique, d'ajouter aux prescriptions de ce règlement, toutes mesures convenables s'ils le jugent utile à la sécurité publique, quand ils sont appelés à examiner les projets de chaque entreprise à autoriser.

En outre des mesures qu'il édicte quant aux conditions techniques des ouvrages électriques, de leur disposition générale, de leur résistance mécanique, de la protection des édifices particuliers ou des services publics (télégraphe, navigation, chemins de fer, etc.), l'arrêté annuel du 21 mars prévoit, en l'un de ses articles (art. 36), l'affichage des prescriptions relatives à la sécurité dans les distributions à haute tension. Et c'est là proprement qu'il faut chercher la réglementation spéciale aux accidents électriques.

L'article précité dispose que les chefs d'industrie, directeurs ou gérants, sont tenus d'afficher dans un endroit apparent des salles contenant des installations à haute tension:

1°. Un ordre de service indiquant qu'il est dangereux et formellemente interdit de toucher aux pièces métalliques ou conducteurs soumis à une haute tension, même avec des gants en caoutchouc, ou de se livrer à des travaux sur ces pièces ou conducteurs, même avec des outils à manche isolant;

2°. Des extraits de l'arrêté technique et une instruction sur les premiers soins à donner aux victimes des accidents électriques rédigée conformément aux termes qui seront fixés par une circulaire ministérielle.

La circulaire ministérille ainsi prévue a été adressée à tous les services du contrôle le 24 mai 1911, après avoir fait l'objet de longues et sérieuses études. L'administration, jugeant en effet que les instructions antérieures ne répondaient plus au progrès de la science électrique ni aux conditions nouvelles de l'utilisation de l'énergie électrique, a confié à une commission spéciale, composée d'hommes particulièrement compétents, sous la présidence de M. Georges

Weiss, membre de l'Académie de Médecine de Paris, le soin d'élaborer le texte de cette nouvelle circulaire. Constituée en novembre 1908, cette commission s'est livrée pendant plus de deux années à des expériences répétées faites sur des animaux, particulièrement des chiens, en vue de déterminer pratiquement et avec toute la précision possible en la matière, les phénomènes physiologiques provoqués par le passage de courants d'intensité, de tension et de fréquence différentes. Ces expériences, auxquelles se sont intéressées particulièrement la Société Internationale des Électriciens et l'Ecole de Médecine, ce qui témoigne de toute l'importance qui y fut attachée, n'ont pas porté sur moins de 44 sujets différents.

Sans entrer ici dans le détail des conclusions scientifiques, dont la plupart ne sont d'ailleurs pas nouvelles, auxquelles ces expériences ont abouti, on peut du moins les résumer très succinctement en passant:

1°. Toutes autres conditions restant égales, le danger du courant est en rapport avec l'intensité, du moins jusqu'à une certaine valeur, et avec le temps du passage du courant, ce danger étant particulièrement grave lorsque le cœur se trouve placé dans le circuit.

2°. Toutes autres conditions restant égales, la fréquence, entre les limites de 12 à 75 périodes, ne joue aucun rôle dans le danger résultant d'un contact avec un conducteur électrique.

3°. Le courant alternatif est plus dangereux que le courant continu; avec 110 volts en courants alternatifs il y a des cas de mort signalés.

Toutefois, la résistance du corps ne semble pas varier avec la nature du courant qui le traverse, à intensités égales. Les expériences mentrent que les chiens succombent lorsque l'intensité va atteindre 0.1 ampère en courant alternatif, tandis que la mort ne survient que par des intensités supérieures à 3/10 ampère lorsque le courant est continu.

4°. La théorie qui faisait quelquefois imputer la mort part électrocution à l'inhibition des centres nerveux, et en particulier à ceux qui commandent la respiration, ne semble pas fondée. En effet, toutes les fois que le cœur est exclu du circuit, l'animal résiste, avec des accidents cardiaques et respiratoires passagers, mais sans troubles définitifs; et si, dans certaines expériences on a pu noter, en même temps que l'arrêt du cœur, un arrêt momentané ou définitif de la respiration déterminant une asphyxie consécutive, on est en droit d'attribuer cet arrêt de la respiration à une contraction musculaire du thorax qui détermine la compression des organes respiratoires: cette contraction peut d'ailleurs être provoquée si on lance le courant dans le corps d'un animal mort depuis quelques instants. Elle doit donc être rattachée à une action musculaire excluant l'intervention prédominante du cœur; et il est encore à noter que dans le cas où les électrodes sont placés sur le crâne et sous le menton, la respiration se rétablit seule, lorsque le courant cesse de passer, si, d'autre part, le cœur a repris ses mouvements normaux. Dans certains cas la respiration à peu près suspendue, 80 à 90 secondes, reprend tout naturellement son cours régulier, lorsque le courant est supprimé: constatation des plus importantes à retenir pour les soins à donner aux foudroyés.

L'observation la plus grave, qui se rattache à la conclusion No. 1 rappelée ci-dessus en termes généraux, est celle qui fait varier le danger du courant avec son intensité: on est en effet conduit par les faits observés à conclure que les courants industriels employés dans les applications domestiques et en particulier à l'éclairage, peuvent, dans certaines conditions de contact, devenir dangereux et même mortels. Il suffirait pour déterminer la mort qu'une intensité de courant 0 ampère 100 fût possible à travers le corps de la victime. Certains accidents survenus dans ces dernières années confirment cette conclusion.

De ces expériences sont sorties les instructions portées à la connaissance des industriels, des ouvriers électriciens et du public, sous la forme de deux affiches, dont l'une s'adresse aux ouvriers électriciens, l'autre au public en général.

La première est destinée à être placardée seulement dans les usines. La seconde doit être placardée, par les soins des industriels, à l'extérieur des usines et au voisinage des lignes à haute tension. Les préfets des Départements et les ingénieurs des services de contrôle locaux ont été invités en outre à la faire apposer aux portes des mairies et dans les écoles. Plus de 100,000 exemplaires de cette deuxième affiche leur ont été adressés à cet effet: un seul Département, silonné de nombreuses lignes électriques, le Départment du Nord, en a demandé à lui seul 4,000. Les autorités municipales ont été engagées à multiplier un affichage destiné à permettre au public de secourir les victimes des accidents électriques et de se garder des dangers qui menacent, en pareil cas, des sauveteurs ignorants ou imprudents.

Les instructions contenues dans les affiches ont été rédigées avec un souci prédominant de clarté et de simplicité, de manière à les rendre accessible à tous. Il ne pouvait être question de faire figurer, dans des documents destinés à la masse du public, aucune des considérations d'ordre théorique et scientifique qui avaient pu, au fond, en inspirer les termes. La commission chargée d'en préparer le texte s'est contentée d'indiquer brièvement les moyens et précautions à prendre pour écarter la victime des conducteurs d'énergie, et les méthodes par lesquelles, en attendant le secours d'un médecin, on peut rétablir, chez l'électrocuté, la respiration et la circulation: traction rythmée de la langue et respiration artificielle. Il était essentiel de ne pas perdre de vue que des instructions plus complètes risquaient d'embarrasser le public auquel s'adressent ces affiches, ou de retarder une intervention dont la promptitude seule assure dans bien des cas l'efficacité. On ne saurait faire un grief à ces instructions d'être sommaires; bien plutôt il les en faut louer.

Est-il permis d'espérer que, grâce à la diffusion de ces avertissements au public, les accidents électriques sont appelés à devenir moins fréquents? Il est à remarquer que la plupart des victimes de ces sortes d'accidents, loin d'être des profanes, sont des ouvriers électriciens ou des travailleurs avertis du danger auquel pourtant ils succombent. Inadvertance et imprudence sont ici plus dangereux que l'ignorance même. Dans la mesure toutefois où une réglementation quelconque peut en pareille matière aboutir à un résultat précis, celle que nous avons exposée nous parait suffire. L'Administration de L'Instruction Publique s'efforce, pour sa part, de répandre dans les écoles primaires françaises les mêmes idées, de pénétrer l'esprit des enfants, dès le plus jeune âge, du péril que présente toute installation électrique et de leur inculquer la notion des mesures essentielles à prendre en cas d'accident. Des conférences sout faites par les instituteurs; des projections mettent sous les yeux des élèves ce que le livre le mieux fait leur ferait mal comprendre. Il semble qu'il ne puisse être de meilleure manière de faire entrer dans l'esprit public les rudiments d'une science que ses applications industrielles multipliées rendent nécessaire à tous.

Le jour où nul n'ignorera ces rudiments, les services de contrôle assurant d'autre part l'exécution stricte d'une législation technique sans cesse renouvelée et mise à jour, on peut penser qu'il ne sera plus rien laissé au hasard, si ce n'est ce que l'homme, avec toute sa science et son meilleur effort, ne peut lui ôter par calcul ni par prévoyance.

WEDNESDAY MORNING, SEPTEMBER 25, 1912.

THE INCIDENCE OF INDUSTRIAL ANTHRAX IN LIVERPOOL.

Dr. E. W. Hope, medical officer of health, city and port of Liverpool, and professor of hygiene, Liverpool University; and Dr. W. Hanna, assistant medical officer.

The incidence of anthrax amongst a community is always closely associated with the handling of infected material, such as carcasses of animals which have died from the disease, or with animal products derived from such sources. Hides, wool, or hair are therefore sources of danger in this respect, and the occurence of anthrax amongst those who handle these and similar articles is a matter of great public-health importance. During the past 10 years or so, we have had the disease under close observation in the port and city of Liverpool. The importation of large quantities of animal products at our great seaport has furnished us with ample material to form the subject matter of this paper.

Anthrax is a disease known in its clinical aspects for a very long time, and is of very wide geographical distribution. Its prevalence in industrial communities has been much studied, and preventive measures of more or less value have been put in force. The results, however, have been in some respects unsatisfactory, and outbreaks and cases still continue to occur. The disease, owing in all probability to the highly protected spores, has resisted our preventive efforts almost more than any other infectious disease.

ANTHRAX IN ANIMALS.

Anthrax is a common disease amongst animals, chiefly of the more or less domesticated kinds, such as cattle, sheep, goats, and so forth, in various parts of the world; but, outside Europe and America, our knowledge of the extent of its prevalence is still far from satisfactory. Especially is this the case as regards China, Siberia, Persia, Africa, and certain parts of South America.

Certain parts of the world are endemic centers of the disease, owing to the lax way in which the infected and dying animals are treated. When an animal shows signs of the first symptoms of the disease, its throat is usually cut or very frequently the owner of the animal, as sometimes happens, knows nothing of the illness until the death of the animal has occurred. The hide or fleece is then removed and sold, should a suitable buyer be in the neighborhood. The carcass may be consumed, or left, with the entrails, to further infect the ground in the neighborhood. It is obvious, then, that where no government control is exercised over the spread of the disease in these countries, no special measures of precaution can be expected from the peasantry. The proper disposal of the carcass is therefore not assured, and, as a result, large numbers of infected hides and much hair and wool are imported into this country and manufactured into leather, haircloth, rugs, felt, and so forth.

The bacilli of anthrax soon die out when dried at ordinary temperatures, but, under suitable conditions, spores are found. The infection, in the form of spores inclosed in blood clots, dried and caked on the hair and wool, is the chief source of spread of infection, owing to the clots breaking up into the form of dust.

The bales of skins and wool which are imported frequently contain infected or " fallen " skins or fleeces which are derived from dead animals and which have been packed up with the good skins and fleeces.

The dust arising in the handling, sorting, and other manipulations of imported animal products is always to be found in more or less quantity where these operations are carried on. Where it is in quantity, the spores are easily carried into the lungs in breathing, or ingested during swallowing. More usually it collects on clothing or finds an entrance into broken skin by a cut or bruise or scratched pimple, being deposited there from the air, or rubbed in by the dusty fingers or clothing.

WOOL.

This term technically includes wool and hair from various animals, chiefly sheep, goats, mohair, camel, and alpaca.

The most dangerous are the dusty wools and those containing fallen fleeces (i. e., from dead animals) amongst them. The wool of these fleeces is dull and lusterless, and has lost much of its elasticity; the practice of false packing, or putting blood-stained material inside clean fleeces, is much more prevalent than formerly; this is chiefly the case in regard to Persian wool. It is a very dangerous practice, and representations on this subject have been made by the anthrax investigation board of Bradford to Persian wool merchants.

The dusty wools and those most likely to cause anthrax are mohair, Persian, camel hair, and cashmere.

HAIR.

Another dangerous animal product is horsehair, derived chiefly from European Russia, Siberia, China, and Mongolia. This hair is collected by agents, who buy from knackers or horse slaughterers and others at various country markets; it is sorted out, packed in bags, and sent direct through Riga, Hamburg, or Antwerp, to England, to hair factories.

Pigs' bristles and pigs' wool also convey infection, although rarely.

HIDES.

Hides and skins for tanning purposes are very often the cause of anthrax in man. The hides are cured abroad in many ways, which vary according to the country of origin.

The curing may be either by drying in the sun, especially in Africa, East India, and South America, or they may be cured by salt or saltpeter, or treated with arsenic solution, as in the case of those from China.

Some hides from India are soil cured, i. e., rubbed with soil which contains a large amount of niter and dried.

The spread of anthrax to cattle in England, by means of imported animal products, has also received much attention. Investigation has been directed to the close association of infected animal products with cattle foods on shipboard, thereby carrying the disease to farm animals. Effluents from tanneries are also very dangerous to cattle grazing on land to which the fluids have access, for it has been shown that the spores of anthrax pass through the various tanning liquors without harmful effects.

The port of Liverpool receives large shipments of all these materials, but chiefly wool and hides. They come from all parts of the world, and large numbers of bales are transshipped to the United States of America.

The cases arising in association with the importation of the foregoing animal products at the port and city of Liverpool numbered 60, covering a period of about eight years; 36 of these were dock laborers or carters engaged in the discharge of the cargoes of ships in dock, and a large proportion of them were infected in the unloading or carting of hides, either loose or in bales; 7 contracted infection in handling horsehair or bristles in hair factories, while 13 were engaged in handling or sorting wools, such as sheep's wool or goat hair in wool warehouses; another case was infected in a local tannery; 2 interesting cases were female bag menders who worked among secondhand bags, and the particular bags on which one was engaged, in all probability, had contained wool or hair, and in the other case the bags had contained dried Egyptian cattle bones. These cases are comparable with 2 at Hamburg, where infection arose in mending tarpaulins which had covered sheep wool. Another case occurred at a patent manure works.

The hides causing infection came from all parts of the world, but chiefly from China and the East Indies.

The material causing inspection in the case of hair was derived from Russian sources.

SITE AND SEVERITY.

The uncovered parts of the skin were, in nearly all cases, affected in the external form of the disease. The site of election in 25 cases was the neck, and in 20 cases the cheek. Other sites for the pustule were the chin, lips, nose, forehead, forearm, and shoulder. In the latter case the man was struck on the shoulder by a box and his skin injured by a projecting nail. He had been handling Rangoon hides at the same time, and carried the infection to the wound with his dusty fingers. In the case of dock laborers the pustule was mostly situated on the neck. The cases were nearly all of a severe type, and there were 20 deaths. It seems very probable that many slight forms of the disease may be overlooked by the patients or be undiagnosed by the medical attendant. This neglect will not occur to such an extent amongst wool and hair sorters and amongst those constantly employed in one special branch of work, who have come to know the early signs of the disease and its dangers. Amongst dock laborers and carters, on the other hand, who are constantly changing the character of their work, this elementary knowledge of the disease will be wanting.

Samples of the hair and hides amongst which the patients worked have been in nearly every case examined bacteriologically, but in few cases have positive results been obtained. The anthrax bacilli, however, have been isolated from samples of hides, wool, and hair which caused infection. It frequently happens that, by the time the case comes to the notice of the health department, the goods have been reshipped or sent to tanning pits or have been divided up. As a rule, however, hides and wool in bales can be satisfactorily traced.

PREVENTIVE MEASURES.

To shortly review the preventive measures in force at the present time we may state that in industrial centers in England the factory and workshops act, 1901, section 73, requires that every medical practitioner attending on or called in to visit a patient with anthrax shall notify the chief inspector of factories at the home office in London. This notification starts the usual routine inquiries and preventive measures taken by the local medical officer of health and inspector of factories.

Regulations have also been made by the secretary of state regarding the handling of dangerous material in factories and workshops.

WOOL AND HAIR.

For example, in factories where wool and hair are handled the regulations are intended to reduce the amount of dust and the likelihood of infection during sorting and handling. These regulations are very complete. Certain classes of wool, known to be dangerous, are scheduled and precautions taken in regard to the opening of bales and sorting by proper steeping or opening over an efficient opening screen with extracting fan. No damaged wool or hair of the dangerous sorts shall be sorted except after being washed. The regulations also advise regarding the storage of wool and hair, and the picking clean of bags without brushing. All the dust in the opening screens and sorting boards shall be discharged into proper receptacles and, in addition, overalls and respirators shall be provided.

The anthrax investigation board of Bradford has done much during the past five years to elucidate the subject of anthrax as far as it affects the wool industry. The investigations have determined that certain disinfectants will effectually destroy the spores when the material can be steeped, prior to washing, in a loose state, so as to afford penetration. This is, however, extremely difficult when dealing with bales containing matted and blood-stained wool.

In the search for anthrax bacilli in wool supposed to have given rise to infection, positive results are more likely to be obtained from samples which give the chemical reactions of blood. Hair and wool containing blood should be sought for and every care exercised in dealing with blood-stained material.

The regulations dealing with the manipulation of horse-hair and pigs' bristles are similar to those for wool. Efforts to disinfect hair by means of steam have been made from time to time, but it has been found to be unsatisfactory, rendering the hair brittle and changing the color of white hair, which becomes yellow.

In Germany elaborate regulations are in force regarding the treatment of wool. They are, in the main, similar to the English regulations.

HIDES AND SKINS.

The precautions in connection with hides and skins are almost as necessary as with wool and hair; the risks arising from infected hides and skins being very great, especially during the importation, handling, and carting.

The rules emphasize that care should be exercised in regard to storage, and the dangers to workmen amongst hides and skins who have wounds or scratches on the body; it is recommended to wear suitable overalls to protect the neck and arms, and it is also advised to wear protective gloves.

Protective gauntlets have been provided for their workmen by many shipping firms in Liverpool, but the difficulty of getting the men to wear them is very great. Gloves are no doubt a protection, but they may also harbor infection by dust finding its way into the interior, and they therefore require occasional disinfection.

Notices have been issued by the chief inspector of factories regarding anthrax, as to the channels of infection, the need of prompt recognition, and immediate attendance at hospital for treatment.

In the beginning of 1906 the cases of anthrax became so frequent that the Liverpool port medical officer, Dr. Hope, issued a circular letter directing the attention of shipowners to the recommendations of the chief inspector, especially with regard to the wearing of gloves. At Hamburg, Marseille, Antwerp, Genoa, and other large ports similar regulations are in force.

In America it is also essential, according to United States Federal law, that all hides imported into the United States of America must be disinfected before shipment in the country of origin, except such countries as are free from contagious or infectious diseases of animals. Unless the imported hides are accompanied by a consular certificate, stating that they have come from an anthrax-free country or have been disinfected, they are not allowed to be landed.

A circular of the United States Treasury Department, dated 1901, directs all customs officers, with a view to preventing the spread of contagious diseases amongst cattle, to treat as prohibited importations all hides of cattle, calf skins, hide cuttings, and so forth, except such as have been dry salted, arsenic cured, or lime dried, after soaking for 40 days in strong solution of lime, and, except abattoir hides, the product of Sweden, Norway, and Great Britain, in all cases where the invoices are not accompanied by proper certificates of disinfection.

It would seem that, in the United States, the authorities regard the dry salting and arsenic or lime curing of hides sufficient to render them innocuous. As far as we can learn, this is the case with hides from India, but great care is exercised in handling hides from China. From inquiries made it does not seem that in America there are any special local regulations for the handling of hides.

Dried hides, whether sun dried or treated with arsenic or lime, are more often responsible for causing infection than the wet kind, and Dr. Hamer, of the London County Council, some years ago recommended the substitution of wet for dry hides. So far, no effort has been made in this direction, the chief factor against it being the increase in weight of the consignment.

The methods of prevention, short of disinfection, which, in the opinion of many, can not be carried out in a practical and effectual manner, may be summarized as follows:

1. Notices and circular letters to educate workmen and their employers.
2. Hides from infected and suspected localities to be scheduled and treated carefully.
3. Dry hides and skins to be imported in large canvas-covered bales, and mechanical means used for removal.
4. Wet instead of dry hides.
5. No hides to be carried on the shoulders.
6. Sheds and store places for wool and hides to be wet cleaned and disinfected.
7. Infected material traced to source and means taken to eradicate the disease.

THE COMPULSORY NOTIFICATION OF ANTHRAX.

Cases frequently occur in Liverpool amongst workers in places which are not under the factory and workshop acts as regards notification; for example, amongst carters in docks and quays and amongst sorters in wool warehouses or skin stores. The local health authorities in Liverpool therefore thought it advisable to make the disease notifiable to the medical officer of health under the infectious diseases (notification) act of 1889. This gives the health department of the local authority all information regarding cases of this disease, and prompt notification and disinfection of the material is of importance to the public health.

CONTAMINATION OF CATTLE FOODS.

The association of the spread of anthrax amongst animals with the contamination of cattle foods with the spores of the bacillus during shipment in foreign ports or during the voyage has led the British board of agriculture to issue a notice to shipowners, pointing out that special precautions ought to be adopted where cargo containing animal products likely to contain infection (such as hides, horsehair, and wool) is carried in the hold to secure the most thorough disinfection of the hold and other parts before such places are used for carrying any cargo likely to be used as cattle food.

In conclusion, the following facts in connection with our efforts in Liverpool stand out as worthy of mention:

1. That the number of cases of anthrax in man shows a tendency to diminish, owing to more care being exercised in handling material.

2. That the deaths are much fewer than in former years, chiefly due to earlier recognition and prompt treatment in hospital by excision and administration of Sclavo's serum.

3. That the danger of anthrax from foreign imported animal products has not diminished.

THE ECONOMIC ASPECTS OF HOOKWORM DISEASE IN PORTO RICO.

Bailey K. Ashford, M. D. Sc. D.; Major, Medical Corps, United States Army; member of the late Porto Rico Anemia Commission.

The island of Porto Rico, with its 3,606 square miles of territory and 1,120,000 inhabitants, is almost exclusively devoted to the culture of sugar, tobacco, coffee, and fruit, named in the order of their importance in 1912; sugar in the coast lands, tobacco in the foothills and some mountain valleys, and coffee in the mountainous regions.

As fully three-fourths of all labor performed on the island is agricultural labor, and the output of each plantation depends largely upon the laboring capacity of those engaged in tilling the soil, given the fact that all vegetation is luxuriant and no serious natural conditions hinder the raising of large crops, a study of the great scourge of the laboring classes, uncinariasis, will throw a flood of light upon heretofore obscure factors in the economic development of Porto Rico during the past 15 years, perhaps through centuries preceding this period.

The value of the coffee crop in 1897, American gold, was $7,492,453; that of sugar, $2,456,898; and that of tobacco, $732,117. Coffee formed 70 per cent of the value of all the exports in 1895–1897, and 41 per cent of all cultivated land was devoted to its production.

In 1910 the value of sugar exported was $23,545,922, representing over 60 per cent of all products leaving the island; of coffee, $5,669,602; of tobacco, $5,664,128.

The total value of articles purchased from and exported to the United States in 1901 was $17,502,103, and in the fiscal year 1910, $68,595,326, a gain within 10 years of 400 per cent.

Thus we see sugar to-day the life-giving product of Porto Rico, with an increase of seventeenfold its value in 1897; tobacco a promising industry which is seven and one-half times as important as formerly, and coffee a struggling industry, which has but 75 per cent of the value it possessed in the days of Spain.

Our study can not embrace a detailed consideration of the economic problem, but let it suffice to say:

1. That sugar rose in value when it came under the protective tariff of the United States.

Coffee fell when Spain's preferential tariff was removed, and although the bean was of a superior class, it was unknown and unappreciated in the only free market open to it, the United States, where it had to compete with cheap grades.

2. That the output of sugar was enormously increased by improved methods of culture and by great mills, now among the largest of their kind in the world.

Coffee culture has progressed very little, if any, in improved methods; first, because, from the nature of the industry, machinery plays an unimportant part in its preparation for the market; second, because the coffee planters were so poor that they were unable to keep their estates at anywhere near their full productive capacity, the bushes needing manual attention continually to increase the output. The value of the crop often barely sufficed to pay the interest on their mortgages, and was totally insufficient to meet the expense of improvements tending to increase their production, especially as loans could with great difficulty be floated.

3. Sugar rose to the surface in an increasing era of prosperity, unhampered by any convulsion of nature, and favored by the benign influences above cited.

Coffee planters were surprised by the war in the midst of speculation and borrowing. Their estates, and even their ripening crop, heavily mortgaged, were visited one year after the American occupation by a disastrous hurricane, which dashed to the ground in a day the coffee bushes and, worst of all, the shade trees, which are necessary for the superior quality of the bean, thus precluding resuscitation of former crop values for at least five years. Many other factors which tended to depreciate the industry might be mentioned, but a fourth element of highest importance remains to be noted.

4. Sugar lands and, to a less extent, those of tobacco, bereft of shade and bathed by a hot sun are notoriously poorer culture grounds for *Necator Americanus* than those of coffee. They are far drier, are well plowed, and well drained.

Coffee groves well shaded, always sopping wet and generally undrained, and, above all, far more densely worked, are among the most perfect culture grounds for this parasite in the world.

Moreover, the laborers in sugar estates were chiefly negroes who are relatively immune to uncinariasis. They were and still are better paid, better housed, and better clothed than the poor white coffee laborer, with a constitution weakened by chilling, damp winds, insufficient clothing, insufficient and improper food, and general poverty and wretchedness.

The result has been that the lands previously cultivated in tobacco and coffee have, wherever possible, been encroached upon by sugar; that tobacco, increasing in importance, has seized upon coffee lands which are very materially diminished in area and driven clear to the mountain fastnesses, where they are generally isolated by lack of roads over which to bring their products to the coast.

We are now in a position to understand why the coffee crop in 1901 was valued at but $1,678,765. In 1904, in part due to partial recuperation of the coffee groves after the hurricane, in part to better prices, it was valued at $3,903,257. From 1904 on, the area of land under cultivation for coffee has steadily diminished and yet the crop has as steadily increased, until in 1910 it was valued at $5,669,902. This means practically but one thing—increase in production. It has not been great but it is perceptible.

Anyone who knows anything about Porto Rico will realize instantly the precarious condition of her commercial future, when one reflects that upon one product, sugar, and the market price of that product, depends her prosperity. Sugar is to-day, relatively speaking, where coffee was in 1897. Let the duty fall from sugar, and tobacco, as yet a weak industry, and coffee, a struggling one, must together support the island. Sugar this day is the mainstay of Porto Rico, but it is far from being the workingman's ideal crop. Only rich men and powerful corporations can grind sugar. Only the big ones financially can supply these mills with enough cane to make them pay. Coffee is the country gentleman's crop, the poor man's crop, the Porto Rican's crop. Even when coffee brought but seven and a half millions of dollars a year to Porto Rico, the "jibaro," or poor white coffee laborer, was better off. His dollar "went further." Coffee holdings are small holdings and they well distribute wealth here. Why was coffee so depressed in 1900–1906, when every other industry was booming? The answer of coffee planters was concise: "There is no coffee!" What they meant was that the per-acre production was utterly inadequate. That this is improving is seen in the figures above cited. The improvement is attributed by some to this factor, by others to that, but no one, no matter how blind, fails to realize that healthy, strong, and abundant labor pays a tremendous part in the future of the coffee industry in the island of Porto Rico.

Thus we can establish the inseparable relation of the health of the coffee laborer to the welfare of the industry; thus we, as medical men, can justly lay claim to a share in the awakening of that industry which in its palmy days brought happiness and contentment to the people of Porto Rico, for in 1904 a campaign was instituted against "anemia," or uncinariasis, the chief cause of the invaliding of the Porto Rican laborer, especially of the coffee laborer, which has culminated in the successful treatment of 300,000 persons of this class. No Porto Rican is capable of denying to the 40 or 50 physicians whose efforts through six years have accomplished this result a part in the financial betterment of his people after this tremendous campaign.

Dividing the island into the municipalities bordering on the coast and those of the interior we find that of the former out of a total population of 618,871 persons, 117,989, or 19 per cent, were treated for uncinariasis, and that of the interior 130,989 of a population of 334,372, or 39 per cent, were so treated. A little over 50,000 were migratory, and their residence could not be fixed. The unit of division, politically speaking, is the municipality, as is the county in the United States, but topographically, while the 24 interior municipalities are in the highlands and chiefly devoted to coffee culture, and secondarily to tobacco, a considerable part of the area of a coast municipality is apt to extend well back into the mountains, and of course such territory is given over to coffee. So it may be said without fear of error that not over one-tenth of those seeking treatment for their anemia were sugar laborers, not over one-fifth tobacco workers, and the rest came from coffee groves.

In the rehabilitation of this coffee industry only one plan is feasible—to increase per-acre production. And to do this workingmen capable of 100 per cent of labor daily are needed. Until anemia among this class is thoroughly under control this will be impossible.

THE LABORER.

He is a tiller of the soil pure and simple, living by sufferance in a rude hut he built, but whose ground he does not own. With a large family he is powerless to save a cent of his earnings, and, as Weyl puts it, it would be a crime for him to attempt it. When not a victim of anemia he is usually a well-nourished, well-built man of medium stature, reserved, deeply suspicious of strangers, unschooled, but astute, generous, and respectful. Again eliminating anemia, his diseases are few, as are his vices. He is long-suffering and, above all, hard working, but his methods of labor are primitive and wasteful. He is totally dependent upon the outcome of the crop he labors to realize, and not being a landowner, unable to read and write, he looks to the planter he serves for protection and ideas.

In the mountains, he is a coffee laborer and a white man. On the coast, he is more frequently a negro or a mulatto, notwithstanding the tendency of late years for the white coffee laborer to work in the sugar fields during the inactive season in the coffee plantation. His food is confined practically to native vegetables and fruits, with rice, codfish, coffee, and condiments. His diet lacks animal proteids and fats, and would be considered below par in Europe and North America. Take away his wage, and he lives from hand to mouth on native fruits and vegetables, for rice, codfish, and condiments he must buy.

That Spain's protection of coffee merely brought about a value of seven and a half millions of dollars in 1897, when, in 1911, five and a half millions were rendered by far less coffee land, without any protection, and with the stormy past already recounted, must be considered notable. Something was certainly missing. When we consider that, from 1890 to 1899, the percentage of deaths from "anemia" to the total death rate gradually climbed from 13 to 22½; when we take into account the testimony of druggists and physicians practicing in those days to the effect that they flourished on the generous sums spent to secure medicine and medical attendance by the laborers; when we realize that when 15 per cent of the total death rate is due to anemia the hemoglobin of the average laborer is not far from 50 or 60 per cent; we can not but see that Spain's best endeavor fell short because of the invaliding of the laborer. Could sugar have attained a value of $25.000,000 a year with a laborer whose hemoglobin is but 60 per cent? We believe not. A sugar planter fights shy of a physical wreck when he is looking for his laborers, for the work is hard, and requires strong men.

When we Americans first landed in Porto Rico, our attention was attracted by the muddy-yellow pallor of the average laborer in the country. At worst, the anemia of uncinariasis is really a rare cause of death in Europe and North America. Even severe cases are, apparently, very uncommon. What is justly feared is the diminution in laboring capacity. But in Porto Rico, with about 300 persons to the square mile, with ideal cultural conditions for the larvæ, and with small coffee estates in whose shady groves hundreds of barefooted workers daily congregate, clearing underbrush or picking coffee, and continually befouling the soil, each laborer receives an almost daily dose of Necator Americanus, a series of multiple infections that fairly break through the most impervious natural immunity, and leave an entire class anemic, with a frightful death rate, impossible to comprehend outside of Porto Rico. When it can be said that 30 per cent of all deaths truly occurred from anemia in 1900, that over 60 per cent of these deaths occurred in the mountains, and that 2 of every 100 died yearly of uncinariasis, has anyone any lingering doubt about the physical condition of the other 98 who lived and were infected under the same conditions as the two unfortunates who lost their lives?

To be more explicit—the hemoglobin of 577 persons presenting themselves for treatment in the Bayamon dispensary in 1904, averaged 43.09 per cent. This was at the very beginning of our campaign, and is an especially valuable note, because Bayamon is a coast town where anemia should have been least prominent, but which, nevertheless, represented the laboring class of sugar, coffee, tobacco, and fruit estates, the industries of that rich municipality at that time.

In the same campaign of 1904–5, of a total of 5,490 treated personally by myself and two associates 22 per cent were light or very light cases, 19 per cent were moderate, 41 per cent were intense or very intense, and 18 per cent were unclassified. In six years' campaign, in which 287,528 persons were treated, 3.99 per cent were very light cases, 20.39 per cent light, 44.90 per cent medium, 25.05 per cent intense, and 4.68 per cent very intense. There was 0.96 per cent unclassified. When we consider that in the majority of instances we did not classify these cases by hemoglobin percentage there may be some objection raised to any attempt at classification, but when we also note that our dispensary physicians had become familiar with the clinical types throughout their life in Porto Rico, and were keen at placing the cases in the class in which they belonged, it will be seen that the error, if there was any, was exceedingly slight. This we know from our own experience, where a series of several thousands were subjected to a hemoglobin examination at the beginning of the work. Our classification by hemoglobin percentage was as follows:

Between 60 per cent and normal, a light or very light case.

Between 30 and 60 per cent, a medium or moderate case.

Below 30 per cent, an intense or a very intense case.

The clinical estimate of the grade of the disease was as follows:

A light case: An individual, previously vigorous and energetic, gradually finds himself losing in strength and inclination to work, with symptoms of dyspepsia and, perhaps, a faint pallor. To his friends and neighbors he is "run down." To unfriendly eyes he is "lazy and good-for-nothing."

A moderate case: A moderately anemic individual, with minus activity of mind and body. The patient looks and feels definitely sick. There is no longer mere disinclination to work, but partial inability. He is pale, exertion brings on throbbing of arteries and palpitation of the heart; sudden changes of position, sudden dizziness. He is half narcotized, as it were.

An intense case: The patient has arrived at that stage when a fatal termination may occur at any time. Extreme pallor, edematous extremities, dilated heart, and so forth.[1]

On referring to the 5,490 cases of 1904, where the taking of hemoglobin percentages on admission was often practiced (upon which percentage the type of the disease was based), and comparing this result with the estimate of the case as established clinically in over 280.000 cases subsequently treated, it will be seen that, by the latter method, the seriousness of each case was rather apt to be under- than overestimated.

In whatever light we choose to view it we can see how sick a laboring class Porto Rico had. My own experience has led me to consider the hemoglobin percentage a fair estimate of laboring capacity where it is between 20 and 85 per cent, although it is wonderful to see the work attempted by an anemic laborer. Below 20 per cent he is usually hors de combat, and above 85 per cent speculation concerning his laboring capacity as affected by the worm he harbors is too uncertain. This means that the average anemic workingman in Porto Rico lost 50 per cent in working capacity from anemia.

From earliest colonial days this unrecognized disease has been responsible for the unjust charge of the full-blooded European that the Porto Rican laborer was lazy and indolent, and only after a tremendous cyclone, which threw the coffee worker upon his own resources, was the mask snatched from the face of one of the most pitiful situations known to medical history. When urged by planter, by insular government, by the American people, to arise and go to work, he laid down to die in droves, at last incapable of responding to even dire necessity.

Anemia in Porto Rico, influenced by the special conditions incident to the downfall of coffee, and by the thousand and one factors which go to weaken the resistance of a defenseless and poverty-stricken people to a chronic exhausting disease, deeply affects the laborer, the land owner, and the territory.

THE EFFECT OF UNCINARIASIS UPON THE LABORER.

1. *To reduce his earning capacity.*—Many times he is paid for the work he accomplishes in a day. This is eminently true of coffee picking, where he receives from 10 to 15 cents per almud, or conventional box full. Some planters have two sets of wages, one for a healthy man and another, much lower, for an anemic. Incidentally they state that they lose money on the anemic, even with his lower wage, but have not the heart to turn him off, and so retain him in the hope that he may be cured and swell the numbers of his no-too-numerous workers.

2. *To sap his scanty wage by the purchase of medicines and in some cases, by doctor's fees.*—The amount of patent blood restorers sold in Porto Rico in past years is astonishing. When finance here was at its lowest ebb, after the cyclone, this ghoulish industry saw its best days. Doctors could not possibly reach the sick rural population, had they even wanted to do so, for the municipal doctor has on an average 15,000 people to attend, often more. These were practically all indigent, and 70 per cent were more or less sick. They lived, not in towns or hamlets, but in every nook and cranny of the municipality, nine-tenths of whose population was distributed

throughout the rural districts, unapproachable by roads and generally reached only over breakneck trails. Over five visits a day to such sick was impossible, given a doctor's duties in the town proper, and only the few fortunate ones had a modest fee to tempt a physician's call. The rest had to depend upon the lying promises of patent medicines and charlatans.

3. *To clog his mentality and reduce his spirit.*—"Over all the varied symptoms with which the unfortunate jibaro, infected by uncinaria, is plagued, hangs the pall of a drowsy intellect, of a mind that has received a stunning blow. * * * There is a hypochondriacal, melancholy, hopeless expression, which, in severe cases, deepens to apparent dense stupidity, with indifference to surroundings, and lack of all ambition."[2]

Such people are unable to act on their own initiative, and have to be driven to work and told each thing separately several times before they understand.

4. *To prevent him from avoiding infection.*—The earnings of a family averaged, in 1904, according to Weyl, the expert of the Department of Commerce and Labor of the United States, considerably less than $100 a year, and there was work available upon only four days in the week. Nine months in the year the majority had no steady work, and during the other three months, or at the time of the coffee harvest, the whole family was employed and payment was made, in coffee plantations at least, according to amounts picked. Fifty per cent of a normal picking was 50 per cent lost directly from disease.

Should every cent of the laborer's earnings be spent for food, his ration would still be inadequate for his working necessities. In this way, shoes were an impossible luxury. His miserable physical and mental condition, lack of market from impassable roads, lack of beasts of burden with which to work, made cultivation of garden patches out of the question.

5. *To prevent his seeking employment elsewhere than in the coffee grove.*—The coffee laborer, who is sick with anemia, is not wanted on sugar plantations, where there is less chance of infection and better pay. Thus his infirmity peonizes him and binds him to the grove.

The effect of uncinariasis upon the planter.—1. If the roaming coffee picker could earn but a scant 50 per cent of what he should earn in health, the regularly employed, living under practically the same conditions, could not be expected to earn more. As a matter of fact, even with the ridiculous wage paid in 1904 (30 cents), the planter lost money in inefficient labor. In a visit made by me to a coffee plantation, about two years ago, so remote from the stations for the treatment of anemia that the laborers were nearly all uncured anemics, I was told by the planter that he was thoroughly discouraged, and was about to give up; that he had 1,800 acres of the best coffee land, much of which he could not afford to put under cultivation, owing to the miserably insufficient output of the part already cultivated, and that he calculated his loss from sick laborers at about 50 per cent.

It was then afternoon and the harvest time; the pickers were returning from the grove and depositing their day's collection in the mill. I stationed myself at the door and asked each one what his picking had amounted to on that day, having first established the normal amount which they should have picked per man. The average of some 200 laborers was 50 per cent short of what it should have been, or 2 almudes a day. The amount received for a box full, or almud, varies with the abundance of berries, but on that day was 12½ cents an almud.

So here were 200 people who in one day had lost $50 from a curable and preventable disease. Seeing these poor, rain-bedribbled, muddy, barefooted anemics, one wondered how in Heaven's name they ever brought in the coffee they had picked; and, as a matter of fact, some stated that they had to be helped in by stronger comrades. Of these pickers many were pointed out to me as regularly employed peons of the estate, and these were indistinguishable from the rest, as far as the degree of their anemia went. When the incentive to make as large a picking as possible was only able to produce 50 per cent of a healthy man's output, can we expect that these peons, working by the day and in the same physical condition, should yield more for a wage?

2. With all the peons he could afford to pay, a large part of his estate remained uncultivated, or, if all cultivated, it would be so poorly worked as to yield only a fraction of its normal output.

3. The ideal of the planter is to secure enough peons to almost handle the crop, leaving a minimum to be employed at harvest time, for such itinerant laborers have to be provided during two or three months with lodging, often with meals, and so forth. The larger the number hired at harvest time the greater the expense aside from the wage. In the presence of an anemic peon class no planter can make economic calculations on his crop.

4. There is at present a scarcity of labor in the coffee plantations. Many good laborers have left the plantation to seek employment in the sugar and tobacco fields where the pay is better. But the men who leave are the cured cases of anemia, who otherwise would not be acceptable to the sugar estates. The result is that the planter in the mountains has to pay a higher wage than before and still struggle with his anemics. This is a class that is rapidly disappearing, but the fact remains that it looks as though the coffee men would have to fight anemia to the bitter end and long after the scourge will have

ceased to become a serious menace to the success of the sugar and tobacco industries.

The effect of uncinariasis upon insular and municipal governments.—1. In a country where so large a percentage of the inhabitants live from hand to mouth, without a cent saved for emergencies, in the presence of a disease which palpably affected 70 per cent of the rural laborers and caused, in 1900, 12,000 deaths, the resources of that country are strained to provide for them. About one-half of the taxes are covered into the insular treasury for roads, education, and so forth. Local roads, street construction, and other purely municipal expenditures have to be provided by the municipality. Were this municipality to provide for the proper treatment of all their indigent sick, including expenditures for medicines, it would go irremediably bankrupt. As a matter of fact, the paltry sums appropriated for this purpose never met the situation. In many municipalities the proposals to furnish medicines for indigents were bid upon by local pharmacists and in a month or so the entire amount was spent for the fiscal year. Even these sums of money, not always wisely spent and not large, represented, nevertheless, a great effort on the part of the poor town.

2. The property values naturally depend indirectly on the output and, when the properties are only partially developed, the assessments fail to yield what they should.

3. The laborers employed by the insular government were apt to be the more anemic ones, the best having been absorbed by the plantations. In fact, these very sick were employed on roads at enormous expense, at the time when it was supposed that their condition resulted from starvation, and as a measure of relief to the poor. No one can ever know what percentage of these appropriations was lost from inefficient labor.

When all is said and done, it is plain that to permit the coffee industry to die out in Porto Rico is really unnecessary and very harmful. It is to many minds the crop of crops for the interior of Porto Rico, and its loss will ultimately spell ruin to sugar and tobacco, for these Antillan islands, bared of their trees, become subject to long droughts and torrential washouts. This has actually happened, apparently, on the south coast, where a three to six million dollar irrigation plant is seeking to save Guayama, Salinas, and Ponce sugar. The mountains to the north are scarred and bare, and, for lack of the roots of bushes and the shade of trees to store up and gradually deliver by hundreds of little streams an ample water supply to the rich coast lands below, one of the richest sugar districts on the island is threatened. All of this aside from other considerations already mentioned.

Uncinariasis affects the whole island, directly and indirectly, but it is the chief bane of the coffee industry. To solve the coffee problem, no plan is complete, nor would such a plan be successful, which takes no account of this medico-social problem.

In Weyl's report to the Department of Commerce and Labor of the United States on labor conditions in Porto Rico, in 1904, we find the following:

> One of the most important of all the factors influencing the condition of the laboring classes of the island is the disease of anemia. This disease, which mainly attacks the poor of the island, more, perhaps, than any single factor, impairs the industrial efficiency of the great mass of Porto Rican laborers. The economic importance of the disease can not be overestimated; * * * the disease is so widespread as to be considered practically universal. The effect upon the conditions of the laboring classes of Porto Rico of completely obliterating the disease of anemia would be almost incalculable. Many persons who are now too sick and weak to work would then be enabled to do so and the industrial efficiency, as it is affected by the muscular strength, the nervous energy, the physical endurance, and the intelligent direction of work of the people, would be vastly increased. An energetic movement with a view to the obliteration of the disease is probably the greatest single step which can be taken at the present time toward improving the industrial efficiency of the laboring classes of Porto Rico.

From 1904 to 1910, inclusive, there have been treated for their anemia, by a special service, 300.000 persons, in round numbers. This number will be much increased by adding the fruit of unofficial work, as follows:

1. *Cases treated by physicians not connected with the service.*—To-day there is hardly a physician who does not treat the anemic jibare with thymol. Many times this is done without a previous fecal examination, in spite of our protests, but inasmuch as 99 per cent of such cases are due to uncinariasis great good results therefrom.

2. *Cases treated by religious societies and medical missions.*—Their number is large and they contribute in a most practical way to the general work.

3. *Cases treated by charlatans.*—Remembering what has been said concerning the difficulty attached to reaching a doctor from the remote barrios of a municipality, is it any wonder that the more calculating jibares learn the simple technique of treatment and apply it extensively for a consideration? That this is by no means uncommon is seen by a little skillful questioning throughout these barrios. A vigorous war upon these interlopers has been carried on from the first, but it is hopeless to expect to catch them all.

4. *Cases treated by the family.*—The administration of thymol and salts for anemia is rapidly becoming a family remedy in certain parts, as quinine and calomel is in our South. Even some proprietors of estates are gingerly taking it up. Of course, this, too, is all

wrong, but what can be more natural? Theoretically it is hard to obtain drugs without a physician's order, but in practice it is by no means difficult.

5. *Cases treated by the officials of the anemia service in the intervals between appropriations to continue the work.*—On several occasions there was a hiatus between the ending of the fiscal year and the reestablishment of the anemia service. On one occasion the legislature was convoked in special session for the purpose of providing for the irrigation of the south coast and to reappropriate funds to continue the anemia work, which it had failed to do at the regular session. In these intervals our physicians kept their stations open and worked without pay, although their records were no longer kept as they had been before.

In addition to all this, there have been many thousand cases treated by the present sanitary service, which took over the work on July 1, 1910.

Hookworm disease probably gained its foothold in Porto Rico in 1530, nearly 400 years ago. In 1788 Fray Iñigo Abbad states that the jibaros had "the color and aspect of convalescents." How many years this color and aspect had been observable he does not say, but we can safely affirm that for 200 years Porto Rican anemia had been explained by the compound theory of improper food, tropical climate, and malaria.

To change the fixed belief of a people, the heritage of 200 years, was no easy matter. From 1899, when this anemia was first identified by the writer as ankylostomiasis, until 1904, when the real campaign against it began, was a period of hard work in propaganda and scientific study.

The result of the universal application of a specific remedy for this anemia has surpassed our most extravagant hopes. To-day a bad case of uncinariasis is rare, indeed, along the highways of Porto Rico, where before, in every town where the traveler halted, he was besieged by pitiful beggars in the last stages of the disease, unable to work, and driven by hunger to implore charity from passers-by. Few cases of moderate severity are seen, and, indeed, the color and aspect of the Porto Rican people can no longer be described as that of convalescents.

The mortality from anemia is but one-eighth of what it used to be. The total death rate has fallen from 42 per thousand, in 1899–1900, to about 22 per thousand, in this year, and only in the mountains, in those far-away barrios, unseen by traveler and even by the city-bred Porto Rican, does hookworm still stalk abroad, not, indeed, as it did before, for with the universal treatment of the disease came the universal education of the people, and to-day there is scarcely a jibaro who does not know that no one need die of his old enemy "la anemia."

At the close of each year of work the commission has made it a feature of the annual report to publish letters which demonstrate the enthusiasm and earnestness of those who worked with us to secure our ends. Until 1907–8, our data had been secured from our physicians, who were really best fitted to judge of the results we were obtaining, but, in the last-named year, the municipal officials of 37 towns, in each of which stations had been working throughout the year, were called upon to express their opinion of the necessity for continuing the work. The mayor, voicing the sentiments of the council, and, in some instances, the town council by formal resolution, eloquently appealed for its continuance, citing the improvement in the health of the people, the reduction in mortality, and the saving on the municipal budget for medicines. Many stated that they would gladly bear part of the expense to keep up the work, nine passed resolutions calling upon the governor to convoke the legislature in special session to appropriate funds enough to proceed with the campaign, and practically all paid a tribute to the work that amply repaid its physicians for the thousands to whom they had administered treatment.

Thus we have the expressed approbation and support of the physician, and of the people through their municipal officials. We have a demonstration, eloquent, persistent, of the jibaro's faith in this new "theory" which brought him daily in throngs, over many a weary trail and without the slightest compunction, to our stations. We have the frank expression of the legislature, which, from year to year, has liberally supplied the necessary funds for the maintenance of the work, to a total of nearly $200,000. We have the earnest interest of all the governors of Porto Rico, beginning with Gov. Hunt, in 1904, who, together with the Hon. Régis H. Post, introduced the first appropriation to the present executive, Gov. George R. Colton, all of whom have, year after year, urged upon the legislature the absolute necessity for supporting this campaign.

In short, no class nor condition of people in Porto Rico, hardly an individual, doubts the necessity of fighting anemia and of paying out good money to do so.

Notwithstanding all this, when I began to prepare the paper which I was to deliver to-day, it seemed to me that to all of this testimony should be added that of the planter himself, who could perhaps say, with even more certainty, what these benefits have really amounted to. Accordingly, I addressed a circular letter to nearly 400 sugar, coffee, tobacco, and fruit growers, representing every municipality in the island.

Although there has not been sufficient time since they have been sent for me to have received answers from all, I give after each of the following questions the composite answer made by the 224 from whom replies have been received.

A few of these planters specified no percentage, but all save two express in general terms what the others express in figures.

Among those remaining some occasionally refrain from fixing a percentage in answering some one question. This is especially so of question 4, in which 65 remark simply that "the benefit received is incalculable," or "of course my profits rise with the cure of my peons," and so forth.

First question. What percentage of laborers who could perform a full day's work did you have on your estate in 1909?

Answer. 40. (Average from 178 planters.)

Second question. What percentage of efficiency for labor have your peons gained since they have been cured of their anemia?

Answer. 61.7. (Average from 193 planters.)

Third question. What percentage of anemic peons exist to-day on your plantation?

Answer. 17.5. (Average from 202 planters.)

Fourth question. Do you believe that by curing them your own profits would increase; and if so, by what per cent?

Answer. 40. (Average from 159 planters.)

More than half append to their answers the statement that the money spent in the anemia campaign was the best investment the legislature ever made, or that the campaign should be continued, or that the results were surprisingly satisfactory.

I believe that the sentiment of the planter is best expressed by the following letter (in answer to one of my own inclosing a copy of the paper which I am now presenting to you) from the president of the National Coffee Growers' Association of Porto Rico:

[Translated from the Spanish.]

PONCE, P. R., *July 15, 1912.*

DR. BAILEY K. ASHFORD,
San Juan, P. R.

MY DEAR SIR: In answer to your circular of last June and your communication of the 12th instant I desire to make the following observations:

I have carefully read your interesting work on the economic aspects of the campaign against the anemia of this island, and I do not find anything to add to it, nor do I believe that I should have to make any correction in it. You have said everything. The results of this campaign should not be viewed solely in the light of the notable reduction in mortality shown by the statistics, so far as they refer to uncinariasis, but in the return to the sociologic normal of the large masses which the disease had rendered useless for work, in the work these masses are now contributing to our ever-increasing production, in the number of human beings saved from beggary and the life of parasites, in the corresponding increase in our commerce, and in the general betterment of an important percentage of our people.

The shortness of time at my disposal deprives me of the pleasure of making a careful investigation concerning this matter in order to be able to respond to your questions with exactness. I am not able therefore to answer these questions with mathematical precision, but I can indeed assure you—and this every one here knows—that the laboring capacity of our workingmen has notably increased—to such a point indeed that an infinite number of laborers completely invalided by their anemia, and for this reason absent from their work in the plantations, are to-day performing work that can not be surpassed in any place.

There are two facts that speak with overwhelming eloquence for the value of the anemia campaign:

1. That our production of sugar has been raised from 70,000 to 300,000 tons; that that of tobacco has increased surprisingly; and that the coffee crops, with variations due to the rainfall, are now almost what they used to be before the cyclone of 1899. Moreover, there has not been any lack of personnel to handle the increased production.

2. That in spite of the great number of laborers who descend to the coast, attracted by the work of the sugar and tobacco plantations, they are not missed in the mountain districts of the interior, where coffee is cultivated and where the scourge of anemia was greatest.

In short, I believe that everyone here admits as a fact beyond discussion that the campaign against anemia has powerfully influenced the increase in the laboring capacity of our working people, those who have been treated being to-day as strong as the strongest. The important proposition now would be that government and planter should work together, each in his sphere of action, not only to prevent the disease from invaliding our country people as before, but to safeguard those who have been already cured against a reinfection in order that the fecund work which you and your confrères have done may not be rendered sterile.

With my best regards, I am, yours truly,

X. MARIANI.

When we confront this data with our estimate that 90 per cent of the rural population and some less of the towns were infected with *Necator Americanus* and that 70 per cent of these were more or less sick it will be seen that our estimate was not far from the truth.

We considered that we had to deal with about 800,000 infected at the beginning of our campaign, when the population was 950,000. Three hundred thousand were treated in the six years of existence of the special anemia service, during four years of which that service consisted of Porto Rican physicians under the superintendence of Dr. Pedro Gutierrez. From 100,000 to 200,000 more have received treatment to date which have not been included in our official statistics and 300,000 still require it. But of this 300,000 fully 200,000 are really light cases or simply worm carriers, leaving only about 100,000 who are palpably sick. The majority of those sick are in the hitherto inaccessible mountain barrios.

It is a natural temptation to figure out the millions saved per year to employer and employed; the value of lives which would have otherwise been lost; the impetus which agricultural life has received by raising the homoglobin of the laboring poor of Porto Rico, but

I will leave that to each one who hears or reads this narrative to estimate for himself.

Enough has been said to bring to the consciousness of everyone that scientific medicine has made a whole people 50 per cent better physically than they were before and has played a winning card in bringing about a 400 per cent increase in Porto Rico's commerce.

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[1] Uncinariasis in Porto Rico: S. Doc. No. 808, pp. 40, 41: Ashford and Gutierrey. Government Printing Office, Washington, 1911.

[2] Op. cit., pp. 89, 90.

THE ECONOMIC ASPECTS OF HOOKWORM DISEASE IN THE UNITED STATES.

Ch. Wardell Stiles, professor of zoology, United States Public Health Service.

Our southern vital statistics, especially for rural communities, are so imperfect that an exact, mathematical, and scientific consideration of the hookworm death rate can not be submitted. We may, however, be permitted to make estimates—or "guesses," if you prefer to call them such—and if these are kept within conservative and minimum limits they are more or less justified, especially in so far as they give to the person not directly connected with the hookworm work at least a slight, though imperfect, idea of the problem before us.

The American mind is rather disposed to grasp a mathematical estimate more readily than a description of conditions, and, playing up to the American tendency to express matters in figures, with a dollar mark before them, I will be so rash as to attempt first of all a minimum estimate of our financial losses caused by hookworm disease.

Several years ago, when pressed by a very keen, far-sighted American publisher for an estimate as to the number of cases of hookworm infection in the country, I placed the figure at not less than 2,000,000. Subsequent events have shown that this estimate is conservative.

With conservatism we may, I believe, assume that the potential loss to these 2,000,000 of people averages at least $1 per week or say $50 per year per head. This would give us a total loss estimated at $100,000,000 per year. Cutting this estimate in half, for sake of policy, I believe we are justified in saying that hookworm disease is costing this country at least $50,000,000 per year.

Permit me to say very frankly that this estimate is made simply and solely in order to satisfy that peculiarity of the American temperament which seemingly is much readier to grasp a financial than a humanitarian proposition.

Let us now turn to another line of consideration.

The various influences of hookworm disease may vary considerably according to whether the infection is preeminently a surface infection as on farms, or a subsurface infection, as in mines. In the latter case (the mines), it is chiefly the adult males of a given portion of the population that suffer primarily; in the former case (the farms), it is chiefly the children of school age and the women of child-bearing age upon whom the real brunt of the effects of the disease falls.

For our States the mine infection is by no means to be ignored, but it is the surface infection that is of the greater importance. This fact shows us that despite the injury that may be done to our adult males, it is chiefly our children of school age and the child-bearing females who are the prime factors for our consideration to-day.

If we expect that, by visiting our southern cities or by studying the present imperfect vital statistics of our registration units in the South, we are going to obtain even a fragmentary conception of the hookworm situation, we are most superlatively in error. The best we can do at present is to take some specific examples of various types, ask you to multiply them mentally by 10 to 100,000, according to the circumstances, and then leave the general results to your imagination, with, however, the caution that it is utterly impossible for any person to gain a true picture of the subject without actual field experience in the open country.

First, let me take two examples of public schools visited since September 1, 1912.

At X—— there is a white school with about 60 pupils. The teacher is an energetic, ambitious, sensible man. He begged me to visit his school because he was conscious of the fact that he was not succeeding in getting these children to absorb as much education as they should. It needed only a glance at the pupils to see where the trouble was. If there was a single pupil there who did not have hookworm disease, the fact escaped my attention. This man was endeavoring to teach 60 anemic, half-starved brains, belonging to children, a number of whom were only 20 to 50 to 80 per cent of normal as respects their hemoglobin.

At Y—— there is a school in which I saw 29 pupils, all but one or two of whom appeared to be clinically well-marked cases of hookworm disease. The teacher naively informed me that there were a number of pupils not at school that day as they were sick. Two of them I saw at their homes the next day and their hemoglobin was about 20 to 30 per cent of normal.

These schools at X—— and at Y——, are not great exceptions, though I would not even intimate that all schools are as badly off as they. Hundreds of our schools are, however, just as bad as these, and from such extreme conditions the infection varies in degree to a point where the inefficiency is decreased probably by only 1 to 10 per cent.

By this time you doubtless foresee the important point I wish to make, namely, that much illiteracy or near-illiteracy in our infected

States is due directly to hookworm disease, that thousands of children are seriously handicapped and inhibited in their education because of this disease, and that this effect upon their education will follow them throughout life, rendering them in general less efficient producers, less enlightened men and women, less trustworthy and less useful citizens. This economic aspect of hookworm disease can not be reduced to the dollars and cents basis—except at election time.

The presence of any large number of persons, such as the pupils just described, in any district, and especially in a State with a large negro population, of necessity prevents that State from attaining as high a standard as it might attain if hookworm disease were not present.

Let us turn now to a consideration of certain phases of hookworm disease in reference to women.

I show you a picture of a white family consisting of a father, a mother, and five children. The point that this is a pauper family does not interest us at present. All these seven persons have hookworm disease, and five other children—not shown in the picture—died in consequence, directly or indirectly, of hookworm disease, if my information is correct. Let us put sentiment aside and see what the facts mean to this mother:

This woman has been through 90 months of pregnancy, 10 confinements, and practically 240 months of convalescence. In addition, she has nursed 10 infants, has kept house, and attempted to raise 10 children, sitting up with them at night when they were sick; she has watched five of her children die and has had five funerals in her family. No wonder she is prematurely old. One half of her entire maternal life has gone for naught, simply because her husband did not provide a sanitary privy for his family. Multiply this case, please, by thousands, and then attempt to imagine what hookworm disease means as an economic factor to the country in the constant drain upon the health of the mothers and upon the happiness and development of the homes. Here again we have an important economic aspect of the subject that calls for serious consideration.

I have in mind a girl 20 years old, a factory girl, who was able to work only half time. She was a case of absolute amenorrhea and always had been. Her mother told me that seven physicians had treated her but had not helped her. Her father told me that he had been kept a poor man because of the bills for medical service and medicine, incurred because of this girl. She took three doses of thymol, expelled her hookworms, and became a healthy woman, who now makes regular time at the mill, and is the chief support of an invalid father and a broken-down mother. There are many physicians in the country who are correctly recognizing and successfully treating hookworm disease, but it is equally true that there are many practitioners who either can not or do not recognize it, and who are collecting from poor people medical fees for service not properly performed. The 20-year-old girl mentioned, with her financially impoverished family, may be taken as a general example of numerous cases that I have seen.

I am next thinking of a woman who has been pregnant six times, if I recall correctly, but who has never had the strength to carry a single child to full term. An unusually intelligent physician who has known of this case for many years reduces the trouble to the fact that this woman is a typical extreme case of hookworm disease.

The real accumulative effects of hookworm disease in this country seem to me to fall more heavily upon the women of child-bearing age than upon any other portion of our population, and a fair examination into conditions would make it very difficult for us to escape the conclusion that our women, in the infected area, age more rapidly than do the corresponding women of our noninfected areas. This too-rapid aging of our home makers is a matter of great economic importance, for it tends to the lowering of the standards of the infected homes and, hence, the standards of the infected localities.

With a home standard lowered by disease and with a school machinery handicapped by lowered hemoglobin and high verminous intoxication in its pupils, and even in many of its teachers, it is not strange that many localities—in fact, many counties—are economically backward. That hookworm disease is not the only factor that comes into consideration I take as self-understood, but that it is the chief handicap of hundreds of thousands of Americans in certain counties I see no valid reason to doubt.

In our infected districts we have many different points of view regarding religion, politics, economics, and various other matters, but I believe there is at least one conclusion upon which we can all agree, namely, that there is a scarcity of efficient labor, both on our farms and in our factories.

Since it has been demonstrated that hookworm disease is present and even common, both on the farms and in the factories in many portions of a number of different States—since, further, hookworm disease lowers the condition of the blood and hence the efficiency of infected persons, it is not unreasonable to conclude that hookworm disease is one of the important factors in the scarcity of efficient labor.

It would be an easy matter to take you to localities where at least half of the farm laborers or half of the factory hands show hookworm infection, with resulting anemia, enlarged hearts, weakened bodies, and lowered mentality. You and I may differ as to the importance of the rôle played by the hookworms in these lowered factors that go to make life happy, but if you wish to dispute the claim that hookworm disease is one of the most important factors in explaining our scarcity of efficient labor in the infected districts, I should like to argue the matter with you in the factories and farms employing hookworm labor rather than in a city in which hookworm cases are rarely seen.

A scarcity of efficient labor, a lowered standard of the home, an inhibited mental development, an increased illiteracy, a tendency to wear out before it is time, especially upon the part of the mother—all of these are factors that are distinctly favorable to the development of child labor—without, of course, being the only factors involved in this unnatural economic monstrosity; and as I see families going from the infected farms to the mills, often with broken-down mothers, often with inefficient and illiterate fathers, I am not at all surprised to see the amount of child labor that exists in the factories of our infected districts; in fact, the surprising thing to me is that child labor is not even more common and more extreme than it is now.

One word as to the relation of hookworm disease to the subject of immigration, and I will close. Because of the undeveloped condition of certain areas, and because of the scarcity of efficient labor, there is a more or less widespread demand for immigration. That this demand should receive support from the commercial organizations is not surprising; but I believe there is another legitimate point of view, namely, first, in our hookworm-infected districts our problems are complicated enough already without introducing among us a large number of foreign laborers who do not speak our language or know our customs; and, secondly, if we will improve our sanitary conditions and thereby reduce our diseases and deaths, the natural increase in our own people, combined with the increased efficiency resulting from better health, will meet the labor demand. We do not need more immigrants half so much as we need more privies to prevent the spread of hookworm disease and of other soil-pollution infections.

DISCUSSION.

Wickliffe Rose, administrative secretary of the Rockefeller Sanitary Commission: In the light of our present knowledge the economic significance of hookworm disease can not be stated in definite terms; but when one lets his imagination play upon the facts which we do have, one is driven to the conviction that the economic loss resulting from the disease is enormous.

Dr. Stiles has given you specific examples of economic loss resulting from the disease in the States; Dr. Ashford has presented an impressive array of facts from his own experience and the experience of the employers of labor in Porto Rico. When I traveled over that island with Dr. Ashford, I learned that the physically sound coffee picker was picking from 500 to 600 measures of coffee per day. Scores of anemics told me they could pick only from 100 to 250 measures per day. When I had thus seen what the disease meant for the individual worker and had visited a large number of plantations where I saw 90 per cent of the laborers infected, I was prepared to understand when the managers of these estates told me that the disease had reduced the efficiency of their labor to from 35 to 50 per cent. When I had seen what it meant for one plantation and had seen the prevalence and severity of the disease over the island, the conviction was borne in upon me that to that one little island, with its 3,600 square miles of territory and its 1,000,000 of people, the economic loss due to this disease has been and is enormous.

With such standard of measurement in mind we can begin to comprehend something of the economic significance of the disease in the large, when we let our imaginations play upon the wide distribution of the infection and the degree of infection in the infected areas.

Through the good offices of the Department of State, the Rockefeller Sanitary Commission has been able to get official reports on the prevalence and degree of infection in practically all countries. These reports, as summarized in the commission's publication No. 6, show that hookworm infection belts the globe in a zone about 66° wide, extending from about parallel 36° north to about parallel 30° south; that practically all countries lying within this zone are infected; that 46 countries in this zone outside the United States, comprising an area of about 14,464,158 square miles, and having a population of about 919,858,243 people, report a prevalent infection; that of the total population of the globe—about 1,600,000,000 people in round numbers—about 940,000,000 live in countries where hookworm disease is prevalent.

In many of these countries the disease is extremely prevalent; in many cases quite as severe as in Porto Rico. The reports referred to above estimate that of the whole population of Colombia living between sea level and 3,000 feet above, 90 per cent are infected; that of the total population of British Guiana 50 per cent are infected, the percentage of infection among the laborers on the sugar estates being much greater; that in Dutch Guiana the infection on many plantations runs as high as 90 per cent; that over a thousand microscopic examinations in French Guiana showed an infection of 35 per cent among a local population, 50 per cent among soldiers, and from 50 to 88 per cent among prisoners; that in Egypt general estimate places the infection at 50 per cent of the laboring population; that 50 per cent of the coolie laborers on sugar and tea estates in Natal are infected, with the disease spreading among natives and Europeans; that on many plantations in Ceylon the infection runs as high as 90 per cent; that of the 300,000,000 of people of India, 60 to 80 out of every 100 harbor the parasite; that on rubber plantations in the Malay States, the infection runs from 47 to 74 per cent; that the southern two-thirds of the Chinese Empire is involved with the infection in many places in the Yang-tse Valley, running as high as 70 to 76 per cent among the farming population; that of the entire population of American Samoa, about 70 per cent are infected.

Seeing what the disease means in terms of working efficiency for the individual coffee picker in Porto Rico, seeing what it means for the owner of the coffee plantation in Porto Rico, seeing with reasonable definiteness what it means economically for that island as a whole, we can understand in general terms at least what it must mean to the countries giving us these reports. Dr. William M. McDonald reports that the disease is "sapping the life and energy of the population of Antigua." Dr. E. Brimont says: "The disease has greatly retarded the development of French Guiana." The report from British Guiana says: "The economic loss due to hookworm disease on the sugar estates is heavy. On one estate, where the laborers were treated on a large scale, the manager reported that the working power of the gangs had increased 100 per cent." Dr. L. F. McDonald, of Queensland, reporting conditions in the Johnston River district, says that "It is sucking the heart's blood of the whole community." The right honorable the Earl of Crew, Secretary of State for the Colonies, in his dispatch on this subject to the governor of Ceylon, says: "Having considered the reports from the several colonies, with the observations of the committee upon them, I recognize that the loss of labor caused by the prevalence of ancylostomiasis is very serious and effects prejudicially not only the employers of labor, but the community at large. Not only is there serious loss of life, direct and indirect, but also through the invaliding of laborers the charges for hospital and pauper expenditures are largely increased."

In closing I repeat: We can not at present state in definite economic terms what hookworm disease signifies; it is only by letting the imagination play upon a summary of such definite facts as we do have that we get some appreciation of what the disease must mean for a country like India, with its 300,000,000 of people and from 60 to 80 per cent of them infected, or of what it means for civilization, with more than half the population of the globe living in countries where the infection is prevalent.

Dr. Claude A. Smith, Atlanta: There is an optimistic side to the health and economic aspect of hookworm disease in the South United States. It is true that as the stunted hookworm patient reaches the age of 15 years the parents dress it as an adult, and additional infection rarely follows on account of protection of shoes. As a result in eight years all infection has died out and the patient reaches delayed maturity with a slight loss of earning capacity.

This is one of the means of preventing continued ill health and economic loss. The extensive work being done by Rockefeller Commission under Dr. Stiles and other measures cause us in the South to have an optimistic view of the hookworm situation.

Dr. Ashford: I desire to call attention to the palpable loss suffered by the anemic laborer who earns but 25 cents a day, while his healthy companions earn 50 cents. This may occur through the reduction of the wage, on account of his physical inefficiency, or it may occur through incapacity from disease when he is paid only for amount of work accomplished.

In reply to Dr. ——— I would inform him that the anemia of uncinariasis is a pure secondary anemia, with a 0.50 color index, absence of leucocytosis, microcytosis, polychromatophilie, and poikilocytosis. One of the characteristics of a medium or light case is eosinophilia. Usually this lies between 10 and 20 per cent. It reaches 68 per cent in one of my cases, but in severe cases it is as likely as not to be conspicuous by its absence. When absent the prognosis is affected unfavorably. But in these severe cases one frequently sees this secondary anemia take on a primary form with high color index, macrocylosis, etc.

Some of the phenomenally low hemoglobin readings may be due to increased volume of the blood by hydremia, as first brought out by the Boycott and Haldane of England. This factor, however, is not of great consequence in many cases.

OCCUPATIONAL BRASS POISONING: BRASS FOUNDER'S AGUE.

Dr. Emery R. Hayhurst, Chicago, Ill.

INTRODUCTION AND DEFINITIONS.

1. *The alloys.*—Brass is an alloy composed of copper and zinc. Fine brass or red brass contains 2 parts of copper and 1 part of zinc. However, as these two metals combine in practically all proportions, many alloys are possible. As zinc is by far the cheaper of the two component metals, its percentage in the alloy is likely to be much increased, until a so-called yellow brass is produced, in which the zinc component may be from 40 to 50 per cent. This the workmen style "cheap yellow brass."

Bronze is an alloy consisting of copper and tin. Usually the copper component is about 9 parts to 1 part tin. In the industry, however, red brass is very often styled bronze, although zinc is the other component instead of tin. It is only rarely that these two or three metals are used exclusively in the particular alloy to be made, but, for the purpose of conveying certain physical properties to the casting, certain other metals are added, such as lead, aluminum, phosphorus, nickel, and antimony. There are some threescore of these various compositions which are well known and are made up for certain purposes (brass, bronze, German silver, aluminum alloys, type metal, and so forth).

In the usual foundry practice, these various alloys are not made by putting in certain proportions of the various metals, but, as a rule, a large percentage, from one-third to one-half, on the average, of scrap brass, copper, and bronze, consisting of all sorts and compositions of metal gathered up usually by junk dealers, is melted down, and then a little of the proper copper, zinc, or nickel ingot added to arrive at an approximate composition. In fact a large amount of the so-called virgin copper, zinc, and other metals which are used, is bought from refiners of scrap metal, and the composition is very uncertain. Certain foundries make a specialty of yellow brass castings, others of red brass or bronze castings, others of German silver, and so forth, while the refiners are concerned with the handling of all of these metals and usually with a large amount of lead.

Consequently, the brass-manufacturing industry, or, more properly, the nonferruginous metal-working trade, is engaged in the handling of large amounts of copper, zinc, and tin, while it must not be overlooked that lead, antimony, nickel, phosphorus, arsenic, and cyanide compounds sometimes enter into these industries, as well as the handling of concentrated and fuming acids (muriatic, sulphuric, nitric, and hydrofluoric).

Finally scrap metal, old boiler tubes, and so forth, by the action of air and moisture, may be covered with more or less poisonous oxides and carbonates, by which ignorant workmen may be poisoned both through handling and breathing the metallic dusts. In addition to the metals above named, as entering into the composition of various brass alloys, the salts with which they are combined to a limited extent require some notice, such as the oxides, the sulphides, the sulphates, silicates, and nitrates.

2. *Pseudo-brass poisoning.*—Direct toxic effects due to any of these alloys of zinc, copper, and so forth, in the cold metallic state, when these come in contact with the tissues of the body, are of mechanical traumatic significance only, with whatever possibilities subsequent infection may add. As is well known, also, the salts of some of these metals have a local effect which is astringent to caustic. The inhalation of dust of any of these alloys, as, for instance, among polishers, buffers, and grinders, in the industry, does not produce the symptom complex known as "brass founder's ague," which is

to be described shortly. An investigation made by the Illinois Commission on Occupational Diseases,[1] 1910, among some 2,000 brass polishers and buffers, failed to discover any affections peculiar to brass dust itself, nor did it appear to be any more harmful than iron dust to iron workers, or stone dust to masons and stonecutters. It is true that these workers suffer from chronic bronchitis in proportion to their exposure, and rapidly develop respiratory affections. According to Lehmann and Saito,[2] the great bulk of inspired dust finds its way into the stomach, not into the lungs, as has been confidently assumed. Obviously, inhaled dusts are collected in the upper respiratory passages, and either discharged directly therefrom, or swallowed, while less than a quarter reaches the lungs. This would be particularly true of these heavier metallic dusts.

The dusts from alloys rich in copper generally produce in workers green-stained hair, a greenish deposit on the teeth and gums, and a green tint to the perspiration, which may persist briefly even after a thorough bath, but all of these are without direct effects upon the health. Such findings are much more pronounced among copper workers than brass workers. Literature teems with references to the relative harmlessness of copper upon the human organism. It has been found accumulated in all the organs of the body, and even in the bones of former copper workers, which have shown a green discoloration, when later removed from graves. About 75 coppersmiths interviewed in Chicago were found to be uniformly healthy. Many of these were old men who had been at the trade from 30 to 50 years. This agrees with the observations of others.

" Brass itch " is a rather common condition among brass polishers and is due to the slight irritation of brass dust, combined with habits of uncleanliness, and is more prevalent in hot weather. Brass foundrymen, however, are singularly free from these green discolorations of hair, teeth, and perspiration, for the obvious reason that they are very little exposed to brass dusts.

3. *Limitation of brass poisoning.*—Brass poisoning may then be narrowed down, even in the industries, to those exposed to the inhalation of fumes arising from molten brass within the brass foundry. Hence the affliction brass poisoning is unknown outside of the industry. Brass, in any condition of temperature short of that of the recent vaporous state of its components, produces no intoxication peculiar to itself.

4. *Brass founder's ague* (brass chills, Giessfieber, Staubfieber, fievre des fondeurs. The workmen use cruder terms, such as " the shakes," " smelters' snakes," and " zinc chills ").—This is the theme of interest in occupational brass poisoning. Without question it is a symptom complex peculiar to the human being. Numerous investigators have failed to produce the ague features in lower animals by inhalation of

brass fumes, intratracheal insufflations, ingestions, instillations, or injections.

Brass founder's ague may be defined as an acute malarialike syndrome of chill, fever (sometimes), and sweat, appearing a few hours after the inhalation, for a few minutes or longer, of the vapors or fumes arising from molten brass or from the fumes of pure zinc alone,[3] affecting only or mostly those unaccustomed to such exposure. It is further characterized by the development of a form of temporary immunity and absence of immediate serious or fatal consequences, a lack of definite pathology, and the probability of the development of nonresistance to secondary affections which account for the increase in the morbidity and mortality of persons so exposed.

The symptoms, which appear usually several hours after the pouring of brass or after an exposure to the metallic smoke arising from the metal, set in with a dry, parched throat, an irritating and unproductive cough, a feeling of constriction in the chest, lassitude, more or less anorexia, followed occasionally by nausea and sometimes emesis. Within one to four hours chilly sensations begin to be noticeable, while a slight dull headache develops. The workman usually lies down or takes to his bed. The chills rapidly increase into a distinct rigor, which may last from a half to two or three hours. No amount of external heat or blankets appears to lessen the rigor. Also there is a great desire to imbibe hot drinks and stimulants. Accompanying the chills and rigor there are usually muscular cramps and sharp joint pains. The victim feels that he is deathly sick. These symptoms end almost by crisis and are followed at once by a most profuse perspiration, while the prostration lasts for several hours longer. In many cases there is a distinct rise in temperature during and following the chills, but it is not constant and may be subnormal. It does not usually mount high. Following the stage of perspiration the victim, quite prostrated, falls into a deep and restful sleep, from which he awakens with no remaining symptoms of his recent experience other than a little exhaustion, perhaps a metallic taste in his mouth, and a temporary loathing of food. The entire attack usually lasts from 5 to 20 hours, seldom longer.

During the chill the pulse is small and rapid (120 to 130 per minute). The respiratory rate is not much affected. The blood findings during and after a chill have been reported by most investigators as entirely normal, although some have found a slight leukocytosis. The urine, after a severe chill, invariably shows albumen and casts which clear up within a day or so. In 1906 J. Sigel[4] proved the presence of zinc in the urine. This has since been verified by Lehmann, Arnstein, and others. Sigel also proved the absence of carbon-monoxid hemoglobin, as an etiologic factor, by spectroscopic examination of the blood. Weyl[5] comments on associated splenic enlargement.

There are many conditions which seem to influence the onset and severity of brass chills. The newer workmen, or those who have returned to work after a week's vacation, perhaps only after a day or so off, as over Sunday, are the most liable. Unless the exposure to the metallic smoke and vapors has been unduly severe, the workman continues at his vocation all day without noticing untoward health effects. It is usually after leaving the workshop at night that the sickness comes on. Many state that as soon as the cold outside air strikes them the chill is inaugurated. Hence the chills are far more common in the winter than in the summer. Many state that while riding home in the street cars, or perhaps on removing the clothes to go to bed in the evening, after a previous period of indisposition, the chill begins. The men claim that it is because they breathe more vapors in the winter than in the summer that chills are much more frequent in this season. This is because, in an endeavor to keep warm while at work and to keep the furnaces and molds from "chilling," the windows, doors, and skylights are kept practically closed; hence the fumes fail to escape through their usual routes of ventilation, as they do in the summer season.

Brass man's ague occurs almost exclusively among workers in brass foundries, but also in foundries in which zinc, alone or alloyed, is poured. In Illinois the only process in vogue of reducing crude ores to recover the zinc is one of volatilizing the zinc in huge smelters. Here an investigation showed that the men working around the smelters occasionally suffered from zinc chills, or "the shakes," as they were wont to call them. They are not as much exposed to the metallic fumes, however, as men who work in brass foundries. Brass chills do not occur in iron foundries nor in bronze foundries. Neither do they occur among galvanizers, the reason being obvious that in this latter process the zinc is only melted and is not heated above its point of volatilization. The method of alloying is of great influence, as the frequency of the chill, other conditions remaining the same, is in almost direct ratio to the percentage of zinc contained in the alloy.

About 70 to 80 per cent only of workmen seem susceptible to the vapors from brass and experience the chills. Hence some natural immunity seems to exist. Also a tolerance occurs in about 70 to 75 per cent of workmen who work steadily at the trade. A further 20 to 25 per cent sicken more or less regularly, but usually not severely. Only in very rare cases do these attacks occur so continually that a change of occupation is necessary. All factors which tend to lower natural vitality are predisposing to brass chills, especially alcoholism, poor quality of food, such as is consumed by a large proportion of the foreign workmen, irregular hours, and excesses of all kinds. In addition, weak, anemic individuals, young persons, and women are more subject to brass chills than are robust individuals.

According to Simon [6] brass founder's ague is only an acute expression of a chronic malady, and one which rarely or never comes within the range or experience of practicing physicians. This question of chronicity is still a disputed point.

5. *Health of brass founders.*—"The molders consider the fever so commonplace and matter of course—only a few having been exempt and many having had it as much as one hundred times and more—that they do not go or send to the physician on account of same. At all events, physicians on this account have rarely had the opportunity of observing brass-founder's ague." Weyl.[7]

According to Simon [6] the situation is the same in England, and we have found it to be similar in Chicago.[8]

In addition to brass-founder's ague, respiratory diseases are very common (chronic bronchitis and pulmonary tuberculosis), while older workmen invariably complain of gastro-intestinal symptoms, such as chronic dyspepsia, biliary trouble, occasionally gallstones; often they are slightly icteroid. Constipation is the rule among them, and hemorrhoids are a common complaint. Pyorrhea alveolaris and carious teeth are common. The frequency of anemia, ill nourishment, and emaciation has long been cited as characteristic of older brass molders.

The inducement to alcoholism among the workmen is great because of the chonic pharyngeal and laryngeal irritation from which they suffer. Most of the workmen resort to whisky, although only a few declare that it is antidotal. It is, unfortunately, a traditional remedy. There is no proof of its beneficial effects.

According to Tatham:[9]

> They sustain a mortality from phthisis which is in excess of that of occupied males by 50 per cent, whilst they die more rapidly than the average from diseases of the nervous, urinary, and respiratory systems.

Our investigations in Chicago in 1910, although not statistical upon this point, discovered a goodly number of young and middle-aged men invalidated by the ravages of consumption.

> If more proof were wanting of the unhealthiness of brass casters it would be afforded by the fact that a few years ago, though there were 1,200 casters in Birmingham, there were not more than 10 over 60 years of age, and, in connection with the superanuation fund of the Amalgamated Brass-Workers' Association from which casters could at the age of 55 derive benefit, it is an appalling fact that there were only three men * * * enjoying this benefit. (Simon.)

Practically only young men are found to be employed in the industry in Chicago. Employers gave as a reason for this that the older men (those over 40) became too slow for the work. The workmen themselves claimed that they were gradually incapacitated from the inhalation of brass fumes, combined with the strain of piecework. By no means the same condition was found to exist among iron founders, who were engaged in the same identical processes. As is well known, the latter continue at their trade until they reach a fair old age.

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Although the literature on the entire subject of brass founder's ague is very scarce, it is not my intention to enter upon more than a brief summary of it here. The affection was confused with malaria until the year 1830, when Thackrah,[10] in England, first described it as a separate affection peculiar to brass workers. In 1845 it was recognized and described by Blaudet,[11] in France. In 1858 Greenhow,[12] in England, on the basis of his researches, came to the conclusion that "brass pourers and doubtless all workmen who deal with zinc vapors are easily attacked with a disease similar to an intermittent fever of irregular type." In Germany Schnitzer[13] was the first to call special attention to brass chills in 1862. In 1906 J. Sigel,[4] in Wurttemberg, Germany, sums up the entire literature concerning this peculiar malady and adds the results of his own investigation. In America a few articles have appeared in recent years, usually reports of individual cases, among them being one by Moyer and Lavin,[14] of Chicago, in 1904; also one by Pietrowiecz[15] in 1904. The disease, as well as chronic symptoms of brass workers, is also commented upon by George M. Kober,[16] of the President's Home Commission, 1908.

Recent literature deals particularly with the experimental side of this peculiar malady, and the investigations of Lehmann,[3] Arnstein,[17] and Kisskalt[18] have thrown considerable light upon its nature.

ETIOLOGY.

The question of the exact cause of the aguelike symptoms seen among those exposed to brass fumes has been a matter of dispute since the time of Thackrah, some authors claiming it to be an expression of acute copper poisoning, others a zinc intoxication, others arsenical poisoning,[19] and still others have commented on the presence of lead, cadmium, and so forth, in the fumes. The question is a difficult one, because of the number of contaminating metals and impurities encountered in the process of manufacturing brass.

The volatilization of the metals in making brass is accompanied by a display of blue-green flames, scintillating sparks, and marked deflagration, especially of the zinc component. A white smoke arises above the metals, out of which small snowlike flakes sublime.

It is this whitish smoke and its sublimation products that are the cause of brass chills. Many analyses of this smoke and its products have been made, but no two authorities agree on the same findings, as might be expected from the inconstant composition of the alloys producing it. A typical analysis taken from Dangerous Trades, by Oliver, 1902, page 456, is as follows:

Organic matter	39.42
Oxid of zinc	28.82
Oxid of iron	2.78
Copper	1.71
Silicates	9.14
Moisture	9.64
Other matter	8.49
	100.00

Analysis of a similar specimen made for the Illinois Commission on Occupational Diseases [1] gave—

Zinc	44.9
Lead	.8

Others have reported the presence of cadmium, nickel, sulphur, traces of arsenic, phosphorus, and other metals and acids.

Although zinc has always been held the metal chiefly to blame for brass chills, its necessary combination with copper has been stoutly maintained up to 1905, when Sigel [4] first showed brass chills occurring in foundries where no copper nor iron could be demonstrated in the sublimation product. Sigel came to the conclusion that the chills were due to the entrance into the system of metallic zinc in the form of zinc dust and in statu nascendi.

In the fall of 1910 I found that so-called zinc chills existed among the zinc smelters of La Salle County,[1] Ill. The raw ore used consists of zinc blende (sulphide of zinc). These ores contain no copper or arsenic and only traces of iron, lead, manganese, and magnesium: 31 per cent of sulphur is present, as well as oxids and silicates, leaving less than 1 per cent of undetermined matter. However, neither sulphur, silicates nor any of the other metals present are known to produce a chill, fever, and sweat syndrome.

Lehmann [3] was the first to succeed in proving that the syndrome could be produced in man by burning chemically pure zinc. He further concludes that the affection is a direct or indirect zinc poisoning:

> According to the very small traces of zinc, which appear in the urine, to the symptom complex and to the sudden cessation of the phenomena, the idea seems acceptable that a resorption of the cell contents (bacterial or epitherial), destroyed or changed by zinc, in the respiratory tract, may be the cause of the peculiar sickness. A complication of intoxication with an infection through the entrance of living bacteria is imaginable in the more severe cases but certainly only as an exception. Zinc is inhaled only as zinc oxid, not as zinc vapor.

Recently nearly the same symptom complex has been observed in the case of the inhalation of the fumes of other metals, Armit[20] finding a similar syndrome in the case of the inhalation of nickel-carbonyl, the gas formed when nickel volatilizes, also in the case of iron-carbonyl and cobalt fumes. Very little is known as to the actual inhalation of copper fumes, since, like nickel, its boiling point is very high. There is great likelihood, however, that the severe brass chills which workmen suffer in making German silver where it is necessary to fuse nickel (about 1,600° C., which is above the boiling point of copper by 200° or 300°) are due as much to inhalation of copper fumes as to those of the associated zinc. Hansen,[21] a metallurgical engineer, cites some peculiar effects not unlike those due to zinc, which he attributes to copper fumes produced in an electrolytical process. When we consider the relatively low boiling point of zinc, compared to that of all the other metals with which it is alloyed, it is easy to see why these symptoms have been so closely associated with zinc and not, at least in the industries, observed in connection with other metals. Boilings points: Zinc, 830° C.; copper, 1,300° C.; lead, 1,450 to 1,600° C.; tin, 1,600° C.; nickel, iron, and steel, all over 1,600° C. Melting points: Tin, 232° C.; lead, 327° C.; zinc, 419° C.; copper, 1,080° C.; nickel and iron, about 1,500° C. Brass itself melts at about 1,000° C. Hence it is seen that, with the exception of mercury, whose boiling point is 357° C., but the dangers from the vapors of which are well known, zinc is the only metal whose boiling point is commonly reached in the industries.

Kisskalt,[18] who has been impressed by the rise in temperature, occasionally observed in the brass-ague syndrome, has looked up the literature carefully in regard to other metals which have been inhaled, ingested, and injected, and notes significant analogies. After a series of experiment upon rabbits, he concludes as follows:

> 1. Subcutaneous injections of zinc salts will produce fever. This may account for the same in brass founder's ague. 2. Inhalation of mercury often causes fever in man and animals, as well as pronounced respiratory symptoms. 3. Also other heavy metals produce the phenomena of brass founder's ague by inhalation. Vapors of heavy metals inhaled produce more similar symptoms than when taken up by other routes.

At another point in his article he makes the following interesting observation:

> For a long time it was considered that fever was produced by bacteria only; then it was found foreign proteins had the same effect; now heavy metals come to be added thereto. The effects of all seem to be the same. Heavy metals produce proteid precipitation, and so "denatured" protein occurs in the organism, and this produces the fever. Zinc especially causes precipitation in unusual dilution.

In some recent experiments (not yet published) carried on under the Sprague Memorial Institute, Chicago, we have been able, by using

Bertrand and Javillier's[22] calcium zincate method of isolating zinc, and Ganazzini's[23] basic urate of zinc test to verify its presence, to trace zinc, in the case of guinea pigs, which were exposed for as short a time as 40 minutes to the inhalation of brass fumes, through the lungs (6 hours afterwards), and liver and kidneys (24 hours afterwards).

It is very probable that the peculiar toxicity of zinc is due, as Armit has found in the case of nickel carbonyl, to its being introduced in a gaseous form, perhaps zinc carbonyl, and that the zinc is deposited as a slightly soluble compound in a very fine state of subdivision over the immense area of the respiratory surface.

SCOPE OF THE BRASS INDUSTRY.

In brief, this may be said to include all the nonferruginous metal trades, since the brass furnace is used for melting and alloying practically all metals except iron and steel. Zinc is an almost universal constituent, both because it is cheap and because of the physical properties it bestows upon the alloy.

England, Germany, and France are all great centers of brass manufacture. In America, according to the Bureau of Census[24] the products of the industry exceed $100,000,000 in annual valuation, of which over 50 per cent is controlled by Connecticut manufacturers, with a large part of the remainder in the States of New York, Pennsylvania, Illinois, and New Jersey.

The products of manufacture in this industry are exceedingly varied and important, such as trinkets and fixtures of all kinds, chandelier, bed, and soda-fountain parts, valves, couplings, nipples, white metal, German silver, gun metal, bell metal, type metal, aluminum and all its alloys, solders, babbitt, pewter, railway-car journals, and the like.

CHICAGO BRASS MANUFACTURING.

In the summer of 1910 there were 182 brass-manufacturing concerns inspected in Chicago.[1] Of these 89 were found to be engaged in the brass foundry or refining business, representing, in all, 2,212 employees within the foundries. These foundries were found to be located in all manner of places, from basements, midfloors, and top floors in great buildings, to specially built foundry buildings.

It was found that skilled labor was almost altogether employed in the small jobbing and specialty shops, whereas the large concerns, which were usually making standard-type products, had machine molds, and employed large numbers of unskilled foreigners. Women were found to be employed only in core work, usually in small rooms more or less ineffectively partitioned off in one corner of the foundry room. Skilled laborers were found to be mostly Americans, Englishmen, Scandinavians, and Germans. The unskilled, who outnumbered the former by 10 to 1, were nearly all Poles or Bohemians. Twelve of the 89 firms employed union labor only. Most of the large concerns were strictly nonunion, whereas the balance may be said to have been "open shop." It was found that the nonunion concerns and many of the others were united together in an organization known as the Chicago Brass Manufacturers' Association, which maintained a central office, and had, as a principal duty, the employing and approving of workmen.

The question of ventilation in these 89 foundries was carefully investigated. It was found that 45 were so situated that surrounding buildings interfered with whatever natural ventilation they had. That in only 6 were the furnaces located in a separate room from molding and casting quarters. Only 12 firms had a separate core room, whereas over one-fourth of the total firms had not provided separate quarters for processes strictly ulterior to foundry work. Practically everywhere only natural ventilation by means of roof apertures, windows, and doors was depended upon to free the foundry quarters from the noxious vapors of molten brass. Only 9 had made any attempt at artificial ventilation, such as suction fans, blow fans, and so forth. Adequate ventilation, especially as regards any sort of inclement weather, was found to exist in only 22 places, and in none of these could it be considered better than fair.

Light was found to be good in 50, fair in 21, poor in 17, and artificial only in 1 foundry. Temperature was unduly hot in 25 foundries, whereas it was found that nearly one-half depended upon soft-coal stoves for general room temperature in the wintertime, and not a few upon open salamanders. In many places the general sanitary arrangements, such as facilities for washing, places for changing clothes, and toilet rooms, were either lacking or very inadequate and usually fully exposed to the foundry vapors and fumes.

In no foundry was room space found to be less than 500 cubic feet per person. It is quite evident, however, that foundries should not have their cubic air space measured on the same basis as that of a living room or even a workshop room. The height of roof or ceiling was noted in each foundry and showed that in 26 it was 12 feet or less. When such was the case, with the absence of overhead ventilators, the escape of brass fumes from furnaces and during pouring was greatly hampered. In only two places were special rooms provided as eating quarters, and it was found that the workmen almost invariably ate their lunches in the foundry room. In most places the first pouring had been completed just before the noon hour, hence the fumes and sublimation products were still in the atmosphere to a greater or lesser extent at that hour.

There was considerable complaint among many brass molders of the constant physical and mental strain required at the present day. It was claimed that a foreman or other expert would set a pace on a certain class of work for a few hours' or a day's time, after which the men were compelled to keep up to this record or be docked on the day's pay. The hours of work in practically all places were found to be from 7 a. m. to 5.30 p. m., with a half-hour lunch period.

The amount of exposure to brass fumes varied considerably in different foundries and, to some extent, with different classes of workmen. In places where pouring was done but twice daily, the exposure was minimal; but where it occurred from 4 to 6 times daily, each time requiring from 10 to 30 minutes to clear the atmosphere, and in several large establishments, where pouring was practically continuous all day, there was an almost constant exposure. In the latter places the workmen often sickened before the day was over and had to quit for the day. The winter season was bitterly complained of by many workmen because of the necessity of closing the means of natural ventilation to prevent chilling of the molds. As a rule the furnace men were the most exposed and the greatest sufferers.

In places where refining of old scrap metal was done, cases of chronic plumbism were occasionally encountered. Also it was found that in nearly all foundries from one-half to 7 per cent of lead was contained in the alloy. Phosphorus was found to be in almost universal use but in limited quantities, and no diseases directly traceable thereto were found. In type foundries and refineries there seemed a liability to antimony poisoning, but no cases were discovered.

Other deleterious influences to which brass founders were exposed were found to be carbon-monoxide gas from improperly ventilated furnaces and the nauseating odors of burnt oil from oil-blast furnaces. Occasionally, where supplementary processes were carried on in the foundry quarters, the atmosphere was found contaminated with metallic dusts from polishing and buffing, with mineral acid and alkali vapors from cleansing processes, and cyanide vapors from plating tanks.

Evidence of occupational disease was closely inquired into at all foundries, both from officials and workmen. There were a total of 114 officials consulted, representing 83 foundries. Of these officials, 31 admitted the presence of occupational diseases in their own plants, 26 others gave interesting statements concerning the same, 46 declared no knowledge of the same, and 11 refused any comment. Of 187 workmen, 146 reported that they were subject to brass chills.

The forms of sickness most commonly complained of were: Brass chills, 45 foundries; smoke inhalations, 26 foundries (especially fumes from oil-blast furnaces); other acute sicknesses, 4 foundries; other chronic sicknesses, 20 foundries (respiratory, gastro-intestinal); temperature variations, 11 foundries; fatigue, 3 foundries.

Of the total of 2,212 men and women in brass foundries, it was found that 451 were engaged in processes which need not have exposed them to the foundry atmosphere. Of the remaining 1,761 actually engaged in brass-foundry work, age statistics were carefully compiled, with the following startling disclosures: 17 over 50 years of age, about 60 over 45 years of age, and about 180 over 40 years of age, leaving 1,500, or 85 per cent, under 40 years of age.

An investigation carried on into the zinc-smelting industry in the Illinois River Valley, where three concerns employed upward of 2,000 men, disclosed the presence of the following industrial diseases and complaints: 1. "Zinc chills," which, from descriptions by the workmen, were exactly analogous to the brass-foundry-man's ague. However, this complaint was found to be of rather infrequent occurrence, as the smelters were not as much exposed to the zinc smoke as brass molders. 2. Lead poisoning, which was of greater frequency than among brass molders because of the handling of crude ores. 3. Summer colics, which the workmen alleged to be due to the drinking of ice-cold water when overheated, but which may have been the expression of a seasonal form of lead colic. 4. Respiratory afflictions, due to breathing zinc fumes, which existed with great frequency and were known among the men as asthma. 5. Carbon monoxide poisoning among the gas-plant workers, as all of the concerns made their own gas, which was used for fuel in the smelters. 6. Industrial alcoholism, which I so name because the workmen consider alcoholic liquors antidotal to various forms of trade sickness.

LIMITATION AND PREVENTION OF OCCUPATIONAL BRASS POISONING.

The chief means of preventing brass-founder's ague lie in the prophylaxis. This consists in proper hygienic arrangements in foundries and smelters, regulation of the habits of workmen, and large roomy quarters. All furnaces and furnace areas should be provided with hoods and stacks to draw off escaping vapors. In addition, ceiling ventilators or skylights provided with artificial means, such as suction fans, or blower systems, to be used in inclement weather, should be provided in every furnace and foundry room. The furnace room should be separate from the balance of the foundry. In large foundries with good ventilation, whether natural or artificial, brass chills practically never occur. The prevention of metallic fumes seems impracticable, although they can be largely absorbed by adding silicates, fluorides, and borate to the slag (Sigel). Adequate light, wet cleansing, and frequent whitewashing should be resorted to. In addition, proper precautions as to lead poisoning, in certain classes of work, as well as the prevention of the other unhygienic conditions mentioned, should be looked into.

Individual precautionary measures, such as sponges, respirators, etc., have a restricted value, but are generally little and reluctantly used. Sickly or anemic workmen, boys, and women, those with a tubercular tendency, and chronic alcoholics should not be employed in brass foundries. The workmen should not eat in foundry quarters, where the air is filled with sublimation products; they should be allowed time for washing up before eating and longer lunch periods. They should be given adequate washing facilities and be provided with shower baths and have suits, at least of outer garments, for use during work hours.

No specific treatment for brass chills has been discovered. The more careful and observing workmen use mild emetics, since they claim that the production of vomiting relieves the distressing symptoms at once, while a good purge seems as beneficial as anything. As before stated, most of them resort to alcohol, usually whisky, but there is absolutely no proof that it has any beneficial effects. Many workmen seem to derive some benefit from drinking hot milk, to which they often add pepper. Sigel suggests that the workmen use sodium bicarbonate to form insoluble zinc carbonate, but says that, inasmuch as most of the metal finds its portal of entry by way of the respiratory system, this can do but very little good.

The State of Illinois has recently provided two laws for the effective prevention of occupational diseases, including brass poisoning, the enforcement of which lies with the department of factory inspection. The first of these came into force January 1, 1910, and is entitled "An act to provide for the health, safety, and comfort of employees in factories, mercantile establishments, mills, and workshops in this State, and to provide for the enforcement thereof."

The second came immediately following the report of the commission on occupational diseases to his excellency Gov. Charles S. Deneen, and has been enforced since July 1, 1911. It is entitled "An act to promote the public health by protecting certain employees in this State from the dangers of occupational diseases, and providing for the enforcement thereof."

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INDUSTRIAL MERCURIAL POISONING IN FELT-HAT MAKERS.

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The association of chronic mercurial poisoning with the carroting process carried out by hatters' furriers has been long known, and as a result many methods of dressing the skins have been suggested as alternatives to the process of carroting, or brushing the fur with a solution of the acid nitrate of mercury, but all the suggestions have so far proved useless in practice or have not had a fair trial, and carroting is still the favorite method of preparation.

It is not my intention, however, to deal here with mercurial poisoning, as it occurs in furriers, but as it is met with in felt-hat makers themselves, in whom, in this country, the existence of mercurial poisoning has been very little recognized, and is only scantily referred to in the literature. In America the work of Dr. Lloyd and in Austria that of Dr. Teleky has brought it into more prominence.

Some three years ago I saw a case which exhibited the symptoms of chronic mercurialism in a hat stover—that is, a man who looks after the hats when the hard-felt shapes are being treated at a temperature of 180° F in the stoving oven. On investigation I found that there were other such cases among the workmen in the same department, but that they were none of them recognized as suffering from mercurialism. On looking up the reports of the medical inspector of factories I found that all the cases notified in previous years in the hatting industry had occurred in furriers, and that no case appeared to have occurred in the felt-hat factories themselves, the furriers' processes being conducted in separate establishments, and the fur being always bought by the felt-hat manufacturer ready prepared.

In 1907, however, the attention of Dr. Legge had been called to the health of the felt-hat workers, and he had examined a series of them, finding definite evidence of mercurial poisoning in a slight degree in some of the men; but apparently none of the cases were bad enough to stop work and be notified, or if, as is more likely, disability did occur, then the correct diagnosis was not made, and the affections were put down as various obscure forms of nervous disease. This, at any rate, is the opinion, as expressed to me, of several medical men in practice in the hatting district. As a result of the investigations with which I followed up the above-mentioned first case—which was sent as one of spinal sclerosis—some 20 cases have been sent to me since, on the observation of which I offer some remarks below.

Some time later two of the workmen applied for compensation under the workmen's compensation act and lost their cases, owing to their not discharging the onus of proof that mercury was used in the course of their occupation, which the respondents refused to admit; in each of these cases, however, an ex gratia payment was made. Last year a third case was tried, and a full award was made after Prof. Walter M. Gardner of Bradford, copy of whose analyses I append by his kind permission, had proved the presence of mercury in the fur used, and I had proved the diagnosis.

THE PATH OF ENTRY AND THE RELATIVE RISKS OF THE DIFFERENT PROCESSES.

The fur blower inhales a considerable quantity of dust, carrying with it the more minute hairs and also particles of metallic mercury; as a result of this a bronchitis, which often becomes chronic, is set up by local irritation. In the cases where the mouth and gums of the blowers are healthy the lungs form the chief path of entry of the mercury to the system, and from the alveoli the absorption is probably easy, though the precise manner in which it occurs remains in doubt; the metallic globules are no doubt oxidized first, then dissolved, and absorption follows.

I wish to mention here that it is only among the blowers and finishers that I have seen any evidence of the undue prevalence of respiratory diseases. In the other departments I have made inquiry and can not satisfy myself that chest diseases are abnormally frequent; and in these latter I did not come across a single case of phthisis. I am quite willing to admit that the advanced cases of mercurial nervous degeneration—cases which have not been recognized as mercurial in the past—may develop phthisis in their last stages, just as any other cases of chronic nerve disease may, and commonly do, develop and die of an intercurrent chest disease; but I think the idea that these workers are especially prone to phthisis dates from the time when the term phthisis covered a much wider field of disease than it does now, and that there is not sufficient ground for the general statement.

In the case of the planker the moist atmosphere containing mercury is such that it can easily be taken in by the lungs, digestive tract, and skin. Once the gums have become unhealthy we have an ideal absorptive surface for the action of the mercurial vapor. From this time the development of the symptoms of mercurialism proceeds much more rapidly. The planker exhibits characteristic anæmia. The typical segs, callosities, and fissures on the planker's hands must not be looked upon as due to the mercury itself; the plankers' acid is responsible for what may be termed a trade dermatitis, and, as far as mercury is concerned, all that can be said is that any open sores or fissures provide especially easy paths for its absorption. The segs and callosities are the result of constant friction.

The readiness with which mercury is volatile at comparatively low temperatures, especially if in slightly acid solution, accounts for the fact that the planker, working at a moderate temperature, is as liable to poisoning as the stover or presser who is inhaling very hot vitiated air.

Most of the workers are quite careless about washing their hands after working and before eating, and very few clean their teeth.

Some chew tobacco while at work, and no doubt contaminate it with mercury from their hands, especially the planker, whose hand is constantly wet. Several of my cases were alcoholic subjects, and I formed the opinion that alcoholism renders them more liable to attack.

SYMPTOMS RELATING TO THE MOUTH AND THE ALIMENTARY CANAL.

In all cases of mercurial poisoning, whether acute or chronic, special attention has to be paid to the mouth, for it is here that some of the most distinctive and diagnostic signs are seen. To those accustomed to cases of chronic mercurialism, some of these signs are quite diagnostic, but others may entirely miss their significance. The profuse salivation met with in acute mercurialism is hardly ever seen, neither does ulcerative stomatitis occur, but slight increase of saliva is the rule. The tongue is large, flabby, silvery, or dove colored, with indented edges. The teeth are blackened, especially near the crowns, and the front teeth more markedly so than those further back. Caries is not often seen, and the process is rather one of erosion. The black eroded teeth are seen in their most typical form in the furriers, and next in the plankers, so that it is a reasonable assumption that the acid fumes play an important part in the causation of this condition. The teeth often show a considerable amount of tartar. Some degree of pyorrhœa alveolaris is common, and pus and blood may often be squeezed out of the sockets. The gums then become retracted, and soon the teeth become loose and may fall out. Legge has shown that they often fall in a definite order. The upper molars fall first. The mouth changes, as a whole, are more marked in inveterate smokers, and most of all in tobacco chewers. Vomiting was complained of in three cases; as a rule at night after work was over, but in two cases occasionally in the morning also. Diarrhea was not a usual symptom.

I have several times heard medical men say, "If he had worked in lead I should have said he had a blue line." This sentence explains fairly well the appearance of the gum margin, though the gum apart from the margin may be quite pale. There is not a blue line in the proper sense of the term, i. e., there is no line of granules, but there is often a cyanosed edge to the gum, which, at a casual glance, can be taken for a blue line. It is an almost uniform line, a purplish blue, not a "lead" blue. I should like to make a plea here for greater care in the diagnosing of a lead-blue line. It is far too lightly diagnosed. Any line, or even any blue line, is not a typical lead-blue line, any more than any spot is a typhoid spot, but to listen to evidence in the county court, on occasion, one feels that some, at any rate, give to it a much broader definition than others.

In some cases there was slight edema of the fauces and palate. The margin of the gum may be swollen.

The question of an odor must be mentioned; in acute mercurialism one has only to have smelt it once to be able to diagnose a case from it again at some distance. This is not so in chronic mercurialism, but I consider that there is a curious odor, definite, though not easy to describe, and not very pungent, but fairly lasting, so that it can be detected after the patient has left the room. Some would call it a metallic odor. It will be gathered, from what I have just said, that I regard this odor as a general one, emanating from the body as a whole, and not as a local odor coming from the mouth, as is the case in acute mercurialism. Some of the men complained of a bad taste in their mouths, but none of them described it as metallic. Anorexia was mentioned as a symptom by two.

One case was quite different from the rest. Here a blower of 25 years' service suddenly got an acute attack, which, from the after history, was apparently mercurialism; he had profuse salivation, diarrhea, and bloody stools; got better, went back to work, and, in a week, tremors began. Yet he had worked all those years with no signs at all. This is the only case I have seen starting more or less acutely, but most of my cases have worked for many years without the tremors—which in almost every case first caused them to seek advice—troubling them really seriously, and there is no doubt, as Dr. Legge has shown, that many of those who are doing their work to-day in the various processes of hat manufacture, are in fact suffering from chronic mercurialism to an extent which is, for the time being, at any rate, compatible with the due performance of their duties. If any further proof were needed of this statement, it is to be found in the fact that the average age of my cases, when they came under treatment, was 42.5 years.

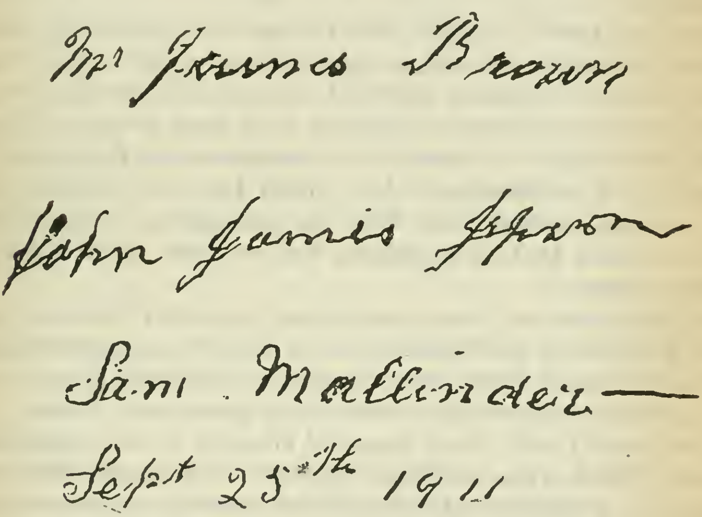
SYMPTOMS AFFECTING THE NERVOUS AND MUSCULAR SYSTEMS.

The symptom for which most sufferers first seek advice is the muscular tremor; this tremor is not so fine as some of the books on general medicine imply; it is rapid, and irregular in amplitude. It is usually increased on voluntary movement, it stops during sleep, and, when lying down, it is much less marked, and, in some cases, stops then also. Charcot did not believe in a mercurial tremor, but thought it to be a rare form of neurosis. Contact of the hands with the rapidly revolving cone may be a factor in its onset in some formers, but this will not account for the bulk of the cases, which occur in the workers in so many other departments.

The presence of this tremor, often called "hatters' shakes," should lead to a systematic examination of the nervous system, but this very rarely brings out any of the definite signs of organic nerve disease. The knee jerks are usually hyperactive, but ankle clonus and Babinski's sign are practically never seen.

The tremor is, as a rule, first noticed in the arms or hands; it may occur first on one side only, or be better marked, or coarser, on one side than on the other. In the cases in which the tremor rapidly becomes general, the speech is often affected. Occasionally, on asking the patient to close the eyes, a fine tremor of the eyelids can be noticed, and others, when asked to show their teeth—or, it may be, in the act of speaking—bring out in so doing a well-marked tremor of the lips and lower part of the face. The tongue may show it also. One man told me that his tremor was always worse when he was cold.

In many cases the tremor is well seen in a specimen of the writing of the patient, as in the appended reproduced autographs. In some of the quite severe cases, however, the writing showed no tremor. Often the tremor itself prevents the workman from doing his work properly; in other cases it merely prevents him from performing the finer movements for himself, such as those involved in buttoning clothes and in lacing and unlacing boots.



Mr James Brown

John James Jepson

Sam Mallinder

Sept 25th 1911

Handwriting of patients with mercurial tremor.

Difficulty in locomotion may be complained of. One patient found great difficulty in getting up when he had once sat down in a chair, and vice versa, due to the stiffness of the muscles of the back, which rapidly subsided when he was taken away from work and put on treatment. Absolute rest in bed for a few weeks hastens recovery in these as in most of the cases.

Formerly some of the cases were diagnosed as disseminated sclerosis. On this issue it must be noted that nystagmus was only met with in one of my cases, while the alterations in the speech, which were sometimes of a stuttering or hesitating character, never assumed a staccato form. The mercurial tremor is finer than that of disseminated sclerosis, but coarser than that of exophthalmic goiter. It is, as I have said, increased on voluntary movement. In one case I found early optic atrophy. Two patients complained of dizziness.

There may be general muscular weakness. The grip is often weak, and the gait may be staggering.

The mental state may be altered; the patient may be in a very nervous state, which has been called—first, I believe, by Kussmaul—mercurial erythism, but I have often noted some loss of memory or slight mental dullness, and these especially in the alcoholic cases.

SYMPTOMS AFFECTING OTHER ORGANS.

Considerable loss of weight is not at all unusual, while many look pale, sallow, and even cachectic; general pains are frequently complained of.

I have no reason to think that the heart is appreciably directly affected by the mercury, and, as regards its effect on the blood vessels, and as a cause of granular kidney, I am sure that the effects can not in any way be compared in severity with those of lead. There is usually some degree of anemia, and complaints are frequently made of coldness of the hands and feet. Both Dr. G. E. Loveday and I have examined several blood films for granulation of the red cells, such as is seen in lead poisoning, but we have never found any granules present.

The lungs are, as I have mentioned, especially liable to attack among the blowers and finishers, but in the formers, plankers, pressers, and stovers, in whom most of my mercurial cases have occurred, I have seen no increased incidence of any pulmonary disease.

In two cases I have found traces of albumen in the urine, but one of these, at least, was a confirmed alcoholic. But though albumenuria has not been a symptom of especially noteworthy importance, scantiness of urine has occurred sufficiently often to be more than an accident. One patient, whose urine was perfectly normal, complained of it, and in those cases which I have admitted to my wards at the Salford Royal Hospital several of the charts have shown this very clearly; in most cases the diminution has persisted all the time the case was under observation.

Mercurial affections of the skin must be separated from those dermatoses met with in persons exposed to mercury, but in whom the skin lesions were certainly not caused by it. To this latter group belong the plankers' cracks, fissures, segs, and callosities, in the causation of all of which mercury takes no part, they being entirely due to the local irritation caused by the acid solution and by the manacles themselves. They have been well figured by Porter in his paper in the British Medical Journal of February 15, 1902.

Of the erythematous and papular eruptions which at times are met with in mercurialized subjects I have not seen any good examples in hatters. Twice I have seen localized scaly desquamation. The very gradual and long-continued absorption of the mercury apparently tells against the causation of skin lesions; they occur from time to time, however, in patients who are mercurialized medicinally.

In England we are not concerned with female labor in those hatting processes in which there is exposure to mercurial fumes, but in the countries where females are engaged in such processes, abortion is frequent in those so employed.

TREATMENT.

Treatment may be divided into prophylactic and symptomatic. As has been mentioned before, all workers in the same department are not equally liable to mercurial symptoms. Some have an idiosyncrasy which early shows itself. I have seen two cases in youths. Others are rendered especially liable by means of alcoholic habits, or by chewing tobacco, or by omitting to wash their hands before feeding, while the vast majority, in fact nearly all, never use a toothbrush and take no care whatever of their teeth. For these the remedy is plain. Pyorrhea must be treated on the usual lines, and many teeth may need removal. Antiseptic mouth washes may be needed, of which sodium phenate and those containing hydrogen peroxide are the best. As the lungs are equally important, or more so, than the gums, as a path of entry, one was not surprised, in one case where all the teeth had been removed and the gums had become quite sound again, to find the tremor and muscular weakness still developing.

For all the processes where fumes are given off and in which dust is thrown out, exhaust ventilation is the great desideratum, and this is now fairly well provided.

The plankers' kettles vary a great deal in the efficiency with which they remove the fumes of the boiling-acid solution. Those which have had continuing curtains of canvas affixed by the workmen to the metal hopper are far the least dangerous. These curtains should, in my opinion, be compulsory, though probably thin rubber would be a more satisfactory material than canvas. In the case of the longer metal hoppers, the continuing curtains are unnecessary, but these do not allow the rinsing to be frequently repeated, as do the short hoppers. It is curious that a simple remedy like the curtains should have been introduced by the men themselves, and while these are merely optional, it is only the most careful of the men who will take the trouble to put them on.

All cases coming under medical treatment should first of all have several weeks' rest in bed; this is good treatment for the anemia and enables the general muscular weakness to be combated by properly regulated general massage, while the weight will be found to rise steadily.

The skin should be kept active by frequent warm baths, and a saline aperient mixture should be regularly given.

Medicinal treatment has in my hands been confined in most cases to the administration of potassium iodide in doses of from 5 to 10 grains three time a day, and I am satisfied that this, in combination with the general treatment outlined above, and the removal from the occupation, does much good. Sulphur, recommended by Arlidge, internally and in baths, I have not tried so far. I have used strychnine with good effect when there was general muscular weakness; it does nothing to increase the tremor. Gull recorded great improvement in the nervous symptoms as the result of electrical treatment.

If there has been one attack, it is advisable for the patient not to return to work in the same department, unless the attack has been a very mild one, one in the causation of which habits have been an important factor, and one which has proved capable of definite improvement.

In conclusion, I would like to especially urge the importance of hatters not returning to their work in a state of debility after an acute illness such as influenza or typhoid fever, as I am convinced from what I have seen, that in this state they are specially susceptible, and even if they have worked for years in mercurial fumes with apparent immunity, it is likely to fail them now.

My thanks are due to Dr. Graham Steell for permission to refer to some of the earlier cases which were in his wards at the Manchester Royal Infirmary, and to Dr. T. M. Legge, the chief medical inspector of factories, for many kindnesses.

Appendix.

SUMMARY OF ANALYSES OF MATERIALS USED IN HAT MAKING.

[By Prof. Walter M. Gardner, principal of the Technical College, Bradford.]

Sample of fur:	Percentage of Hg found.
No. 1	0.09
No. 2	.16
No. 3	.09
No. 4	.14
No. 5	.175
No. 6	.17
In a hat body	.138
In loose hair from planker's kettle	.082
In cloth from continuation curtain	.01
In planker's dilute acid	.001
In strong sulphuric acid used to make planker's acid	nil

The amount of mercury in the hats was thus roughly 1 part per 800, or 1 ounce mercury in 400 2-ounce hats. Arsenic was also detected in the acid.

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DIE GEFAHREN IN DEM GEBRAUCHE DES QUECKSILBERS IN DER INDUSTRIE.

Dr. Karl Heucke, Königl. Gewerberat, Wesel, Rhein.

Quecksilber (Hydrargyrum, Argentum vivum, Mercurius) ist das einzige Metall, welches bei gewöhnlicher Temperatur flüssig ist, erst bei 40° C. wird es fest und kann dann gehämmert werden; es siedet bei 300° C., verdunstet aber schon bei gewöhnlicher Temperatur. Schon im Altertum war das Quecksilber bekannt, und Aristoteles, Theophrast und Plinius geben von Quecksilber Nachricht und als Gewinnungsstellen unter anderen Orten Armenien, Kapadocien, besonders aber Spanien an.

Heute sind uns als Gewinnungsorte besonders Almaden in Spanien, Californien, Böhmen und der Ural bekannt, in geringer Menge kommt das Quecksilber auch vielfach an andern Orten vor, z. B. Olpe in Westphalen, Idria im Kräin, in Kärnten im Steiermark.

Gediegen kommt es in kleinen Tröpfchen im älteren Gestein und im Diluvium vor, legiert auch als Gold- und Silberamalgam; am meisten verbreitet ist es als Zinnober (Schwefelquecksilber) HgS mit 86 Prozent Quecksilber.

Die Weltproduktion von Quecksilber gibt Fischer in seinem Handbuch der Technologie für 1898 auf 4,082 Tonnen an, darunter—

	Tonnen.
Vereinigte Staaten	1,076
Spanien	1,681
Oesterreich	500
Russland	633
Italien	192

Dagegen gibt Ost in seiner Chemischen Technologie für das Jahr 1900 die Weltproduktion nur auf 3,523 Tonnen an, davon erzeugt—

	Tonnen.
Vereinigte Staaten	967
Spanien	1,111
Oesterreich	550
Russland	340

Das Quecksilber und seine Salze werden viel in der Medicin verwandt; ich erinnere nur an den Gebrauch des Calomel als Abführmittel und an das Sublimat als Antiseptikum, sowie an die Anwendung gegen Parasiten und bei Hautkrankheiten, sowie bei Syphilis. Ebenso mannigfältig ist die Anwendung des Quecksilbers und seiner vielfachen Verwendungen in der Industrie. Das Quecksilber wird gebraucht bei der Fabrikation von Barometern und Thermometern, bei der Herstellung von Glühlampen zur Erzeugung eines Vakuums durch Quecksilberpumpen, beim Vergolden und Versilbern, in der Spiegelfabrikation, in den chemischen Fabriken bei der Herstellung von pharmazeutischen Quecksilberpräparaten, bei der Herstellung von Munition (Knallquecksilber), in der Elektrolyse bei der Herstellung von Alkalilange, in Kürschnereien und bei der Herstellung von Hutstoff in Hasenhaarschneidereien.

Sowohl das metallische Quecksilber wirkt durch sein Verdampfung schon bei gewöhnlicher Temperatur, ebenso wie seine meisten Salze ausserordentlich schädlich auf den Organismus so dass alle Betriebe, in denen Quecksilber oder seine Verbindungen gebraucht werden, zu den gesundheitsschädlichsten zu zählen sind, und alle diejenigen, die mit Quecksilber in Berührung kommen, ja selbst diejenigen, die zu lange mit Quecksilber behandelt werden, der Gefahr einer Quecksilbervergiftung ausgesetzt sind.

Ueber die Wirkungen des Quecksilbers und als Zeichen von Quecksilbererkrankungen führt Villaret folgendes an:[1] Anschwellen des Zahnfleisches, welches leicht blutet, leicht geschwürig ist, starker Geruch aus dem Munde, Lockern und Ausfallen der Zähne, starker Speichelfluss. Dann tritt Gliederzittern auf. Die Arme des Kranken bewegen sich stossweise hin und her, besonders wenn der Kranke beobachtet wird oder bestimmte Bewegungen ausführen will; ist er sich selbst überlassen, so wird er ruhig. Auch der Kopf und die Zungenmuskeln können von diesen unwillkürlichen Bewegungen ergriffen werden. Schliesslich tritt die sogenannte Mercurialcachexie bei dem Kranken ein, sie werden blutarm, die Verdauung liegt darnieder, der Mund ist zahnlos, an den Alveolen entwickeln sich Eiterungen, die Muskulatur ist schwach und atrophiert in immer höherem Grade, wie auch das Unterhautfettgewebe schwindet, so dass der Kranke auf's äusserste abmagert.

Auch Schoull[2] schildert die Folgen des Quecksilbers auf den Organismus in seiner Arbeit "Des moyens propres à empêcher les accidents d'intoxication chez les ouvriers sécréteurs" in ähnlicher Weise und schreibt:

> Outre les dermatoses, parfois rebelles, que produit le contact prolongé et répété de la solution de nitrate acide de mercure, dermatoses qui peuvent ouvrir une voie plus facile à l'absorption, outre la stomatile plus ou moins intense à laquelle les ouvriers sont exposés, on remarque assez souvent chez eux un tremblement pouvant acquérir une violence étonnante; des symptômes d'anémie, profonde parfois; des troubles digestifs de différente nature, offrant comme fait remarquable un dégoût pour les substances azotées, et, au contraire, une préférence marquée pour l'alimentation végétale, les substances épicées, acides, etc., choses que leur sont, dans ces circonstances spéciales, éminemment nuisibles; on recontre aussi quelquefois des troubles dans les fonctions génésiques; enfin le produit de la conception peut se ressentir de l'intoxication à laquelle est exposé l'ouvrier sécréteur.

Um diese eben geschilderten Wirkungen des Quecksilbers auf den menschlichen Organismus zu verhüten, sind in den einzelnen Industriezweigen folgende Schutzmassregeln zu treffen.

Bei der Anfertigung physikalischer Instrumente, wie Thermometer, Barometer, ist es nicht zu verhüten, dass Quecksilber auf den Fussboden fällt, welcher deshalb vollkommen dicht und glatt sein muss. Ein Hauptfordernis ist eine augiebige Lüftung und möglichst niedrige Temperatur, da, wie schon erwähnt, das Quecksilber selbst noch bei 0° Dämpfe entwickelt, und diese Verdampfung mit steigender Temperatur zunimmt, so ist eine kühle Temperatur erforderlich, um die Quecksilberdämpfe möglichst zu verhüten, ein Luftzug ist hierbei aber zu vermeiden, da dieser nur zu begünstigend auf die Verdampfung des Quecksilbers einwirkt.

Die Arbeiter müssen möglichst glatte Ueberkleider tragen, die nach Arbeitsschluss in der Fabrik verbleiben, desgleichen eine Kopfbekleidung, sie sind ferner zur peinlichsten Sauberkeit anzuhalten, müssen nicht nur vor dem Einnehmen der Mahlzeiten und vor dem Verlassen der Arbeitesstätte sich waschen, sondern auch jedesmal den Mund ausspülen. Das Essen und Trinken in den Arbeitsräumen selbst ist streng zu verbieten. Arbeiterinnen und jugendliche Arbeiter sind von der Arbeit auszuschliessen, und der Gesundheitszustand der erwachsenen Arbeiter ist ärtzlich zu überwachen.

Für die Waschungen möchte ich Akremninseife ganz besonders empfehlen,[3] dieselbe enthält Schwefelwasserstoff (H_2S) und führt somit das anhaftende Quecksilber sofort in unlössliches Schwefelquecksilber (HgS) über. Obschon mir nicht bekannt ist, ob für das HgS ebenso wie für das PbS (Schwefelblei) die völlige Ungiftigkeit für den menschlichen Organismus festgestellt ist, so möchte ich dies doch annehmen, da sich das HgS genau so wie PbS verhält; denn beide werden durch H_2S in unlössliche Verbindungen übergeführt und in der Natur ist die grosse Affinität des Schwefels zu den beiden Körpern dadurch gekennzeichnet, dass beide Metalle hauptsächlich an Schwefel gebunden als Bleiglanz (PbS) und als Schwefelquecksilber (HgS) bergmännisch gewonnen werden und dass in den Bergwerken selbst keine Vergiftungen vorkommen, erst sobald die Verhüttung anfängt, beginnen die Quecksilbervergiftungen.

Das soeben Gesagte gilt auch für die Herstellung von Glühlampen. Zum Evakuieren der Glühlampen werden Quecksilberluftpumpen verwandt, beispielsweise Sprengel-Pumpen, die nach dem Princip des Quecksilber-Barometers gebaut sind und in ziemlich komplicierter Weise ganz aus Glass hergestellt werden. Diese Pumpen sind sehr zerbrechlich und ist die Möglichkeit gegeben, dass beim Bruch einer Glasstelle sich der ganze Quecksilberinhalt nach aussen ergiesst und sich auf dem Fussboden des Arbeitsraumes ausbreitet und durch Verdunstung und Berührung mit den Händen Quecksilberkrankheiten herbeiführen kann.

Um diesen Gesundheitsschädigungen möglichst vorzubeugen hat das Köngl. Polizei-Präsidium in Berlin am 22. November 1888 eine Verordnung erlassen, die folgendes bestimmt:

1. Der Arbeitsraum (Pumpstation) ist so einzurichten, dass stets frische Luft zu- und schädliche Luft abgeführt wird.

2. Die Beschäftigung der Arbeiter ist so zu regeln, dass den Quecksilbervergiftungen rechtzeitig vorgebeugt wird.

3. Alle in der Pumpstation sich länger aufhaltenden Arbeiter und Beamten müssen mit einem von der Direktion zu liefernden, zu unterhaltenden und wöchentlich einmal durch Waschen zu reinigenden Anzuge aus leinenem Ueberrock und Mütze bekleidet sein.

4. Zur Einnahme der Mahlzeiten muss ein besonderes, mit der Pumpstation nicht in Verbindung stehendes Zimmer vorhanden sein. Vor dem Betreten desselben haben die Arbeiter den oben beschriebenen Anzug abzulegen, sich Gesicht und Hände zu waschen und den Mund mit einer Lösung chlorsaurem Kali auszuspülen.

5. Das Waschwasser, welches Schwefelleber (Kalium sulfuratum, Hepar sulfuris) in Lösung enthalten muss, und die Lösung von chlorsaurem Kali sind von der Fabrik zu liefern. Ebenso ist dafür zu sorgen, dass sich die Arbeiter wöchentlich dreimal unter warmer Douche abspülen und abwechselnd Wannenbäder nehmen.

6. Von Seiten der Fabrik ist ein Arzt anzunehmen, welcher die in der Pumpstation beschäftigten Arbeiter wöchentlich zu untersuchen und auf sofortige Entfernung derjenigen zu dringen hat, bei welchen sich die geringsten Anzeichen von Quecksilbervergiftung bemerkbar machen.

7. Die Beobachtungen des Arztes sind in ein Buch einzutragen welches den revidierenden Beamten auf Erfordern vorzulegen ist. Auch jetzt noch werden in sehr vielen Glühlampenfabriken, namentlich in solchen, die Metallfadenlampen herstellen, die Lampen ausschliesslich noch mit Quecksilberluftpumpen evakuiert, während andere Firmen sich vorzugsweise der Oelpumpen bedienen. Ganz ohne Quecksilberpumpen kann ein modernes Glühlampenwerk nicht wol auskommen, da gewisse Lampentypen sich auf anderen Pumpen nicht gut herstellen lassen.

Es ist indessen ausdrücklich hervorzuheben, dass in neueren Glühlampenfabriken nur noch rotierende Quecksilberpumpen im Gebrauch sind, die etwa nach Art der Gasuhren gebaut sind und in denen das Quecksilber in einem eisernen trommelartigen Gefäss vollkommen hermetisch eingeschlossen ist. Es ist bei diesen Pumpen jede Möglichkeit ausgeschlossen, dass sogar beim Eintreten von Defekten das Quecksilber heraustritt und hierdurch mit der äussern Luft in Berührung kommt. Diese rotierenden Quecksilberluftpumpen sind daher unbedingt als durchaus gesundheitsunschädlich zu bezeichnen.

Zu den gefährlichsten Arbeiten mit Quecksilber gehört die Quecksilberspiegel-Fabrikation. Zur Herstellung der Spiegel breitet man auf einer ebenen, glatten horizontal liegenden Marmorplatte eine Zinnfolie (Stanniol) aus, überstreicht zunächst die Folie mit Quecksilber und schüttet dann 2–3 mm Quecksilber darauf, legt hierauf die sorgfältig gereinigte und polierte Glasplatte, so dass der Rand stets in das Quecksilber eintaucht. Nun wird der Spiegel mit Gewichten beschwert und der Platte eine geringe Neigung gegeben, damit das überschüssige Quecksilber abfliessen kann. Nach einiger Zeit (24 Stunden) legt man den Spiegel mit der Amalgamseite nach oben und stellt ihn schräg (geneigt) auf, damit sich das überschüssige Quecksilber vollständig entfernen kann.

Um den Gefahren, die sich bei diesen Arbeiten ergeben, entgegenzutreten, hat der Herr Minister für Handel und Gewerbe am 18. Mai 1889 resp. am 22. August 1893 für Preussen nachfolgende Vorschriften erlassen, die auch für Bayern gleichlautend am 30. Juli 1889 folgten:

1. Die Herstellung von Quecksilberspiegeln darf nur in Räumen, welche zu ebener Erde gelegen sind und entsprechend kühl gehalten werden können, erfolgen. Die Fenster aller Räume, in welchen die Möglichkeit einer Entwicklung von Quecksilber-Dampf und Staub vorliegt (quecksilbergefährliche Räume) müssen nach Norden liegen.

2. In den Arbeitsräumen dürfen Quecksilbervorräte nicht gelagert werden. Die Aufbewahrung von Quecksilber hat in einem besonderen Raume, in verschliessbaren, gut verdichteten Behältern zu erfolgen.

3. In dem Belegraume darf nur das Belegen der Glastafeln, in dem Trockenraume dürfen nur solche Arbeiten, welche mit dem Trocknen der belegten Glastafeln verbunden sind, vorgenommen werden. Diese Räume dürfen mit Wohn-, Schlaf- und Haushaltungsräremen nicht in unmittelbarer Verbindung stehen. Die Türen, welche die Verbindungen derselben untereinander und mit anderen Arbeitsräumen herstellen, müssen guten Schluss haben, geschlossen gehalten werden und sind nur dann und so lange zu öffnen, als die Arbeit dies erforderlich macht. Der Aufenthalt nicht beschäftigter Personen, sowie der Aufenthalt der beschäftigten Personen vor und nach der Arbeit und während der Pausen in diesen Räumen ist nicht zu dulden.

Das Wischen (Putzen und Reinigen) der Glastafeln ist im Belegraume insoweit gestattet, als die letzte Fertigmachung der Gläser zum Belegen dies unabweislich erfordert.

4. Beim Anwärmen der Wischtücher ist die Verwendung von Kohlenöfen in allen Arbeitsräumen untersagt. In Belegraume und in anderen durch Quecksilberverwendung gefährlichen Räumen dürfen zum Anwärmen von Tüchern nur solche Wärmevorrichtungen (kleine Petroleumöfen) benutzt werden, bei welchen ein Ausstrahlen

von Wärme und eine Erhitzung benachbarter Luftschichten auf das geringste Maass beschränkt bleibt. Werden hierzu Petrolöfen verwendet, so dürfen die Verbrennungsgase nicht in den Arbeitsraum, sondern in einen Schlot entweichen. Die Erwärmung der Luft bei Kälte und ebenso die Abkühlung der Luft bei hoher Sonnenwärme ist für diese Räume noch durch Einführung angewärmter resp. abgekühlter Luft zu bewirken. Die Temperatur der eingeführten angewärmten Luft darf niemals 15° überschreiten. In Lagerräumen, Wischräumen und anderen die Gesundheit der Arbeiter nicht gefährdenden Räumen ist die Benutzung gewöhnlicher eisernen Oefen gestattet.

5. Soweit die Witterung und der Gang der Fabrikation es erlaubt, sind die Fenster der durch Quecksilberverwendung für die Gesundheit gefährlichen Räume vor und nach der Arbeit möglichst offen zu halten.

6. Die Grösse der Beleg- und Trockenräume ist so zu bemessen, dass pro Kopf der darin beschäftigten Personen in den ersteren ein Luftraum von mindestens 40 cbm., in den letzteren von mindestens 30 cbm. entfällt. Die Höhe der Räume muss mindestens 3.5 m. betragen. Durch eine nicht auf natürliche Temperatur-Differenzen beruhende, während der Arbeitszeit stets wirksame Ventilationsvorkehrung (Anwendung einer Lockfeuerung ausserhalb der Räume, eines Gas- Wasser- oder anderen Motors) ist dafür Sorge zu tragen, dass die Luft der Beleg- und Trockenräume bei geschlossenen Fenstern und Türen durch Zu- und Abführung von mindestens 60 cbm. Luft pro Kopf und Stunde während der Arbeitszeit fortlaufent erneuert wird. Die frische Luft ist in die oberen Luftschichten der betreffenden Räume einzuleiten. Die Absaugung der Luft ist so einzurichten, dass die unteren Luftschichten zuerst abgeführt werden. Zu- und Ableitung dürfen nicht an derselben Wand angebracht werden, sondern müssen sich möglichst gegenüber liegen und so eingerichtet sein, dass Zug vermieden bleibt. Der Arbeitgeber ist verpflichtet, diejenigen Kontrollapparate zu beschaffen, welche von dem zuständigen Aufsichtsbeamten als erforderlich bezeichnet werden, um festzustellen, ob die vorhandene Ventilationsanlage den gestellten Anforderungen entspricht.

7. Die Temperatur der Luft in den Beleg- und Trockenräumen ist möglichst gleichmässig zu halten. Erreicht an einem Tage die Temperatur der Luft in diesen Räumen die Höhe von 25° C. und darüber, so ist die Arbeit einzustellen und an diesem Tage nicht wieder aufzunehmen. In jedem Beleg- und Trockenraume ist ein Thermometer anzubringen, an welchem durch eine in die Augen fallende Marke die zulässige höchste Temperaturgrenze bezeichnet ist. Das

Thermometer ist in Kopfhöhe und nicht an der Umfassungswand oder in der Nähe einer Türe oder eines Fensters anzubringen.

8. Der Fussboden der Beleg- und Trockenräume muss aus glattem Asphaltbelag, ohne Fugen, Ritzen und Sprünge bestehen, mit leichter Neigung zu einer Sammelrinne für das auf den Boden gelangende Quecksilber und mit Sammelbecken.

9. Die Wände der Beleg- und Trockenräume sind, sofern sie aus Mauerwerk bestehen, glatt zu verputzen. Wände aus Holz müssen aus gehobelten, gut gefügten und verkitteten Brettern hergerichtet sein und an der Decke und am Boden dicht schliessen. Wände und Decken sind mit Oelfarbenanstrich zu versehen und allwöchentlich abzuwaschen.

10. Die Belegtische und Trockengestelle müssen so eingerichtet sein, dass das beim Antränken der Zinnfolie, beim Uebergiessen derselben mit Quecksilber, beim Pressen der belegten Platten und beim Trocknen der Spiegel abfliessende Quecksilber möglichst schnell in die aufgestellten Auffangsbehälter gelangt. Nach Schluss der täglichen Arbeitszeit ist der Belegtisch sorgfältig von Quecksilber zu säubern. Die Auffangsbehälter sind so einzurichten, dass sie vollkommen verschlossen sind, bis auf eine enge, dem Einlass des Quecksilbers dienende Oeffnung. Die Anbringung von Filtriereinrichtungen ist nur in den Behältern selbst, nicht auf den Belegtischen gestattet.

Das Anreiben (Antränken) der Zinnfolie mit blossen Händen ist den Arbeitern zu untersagen.

11. In Belegräumen und in allen sonstigen Räumen, in welchen Quecksilber verwendet wird, ist die peinlichste Sauberkeit und Vorsicht zu beobachten. Jedes Verschütten und Verspritzen von Quecksilber ist möglichst zu vermeiden. Der Fussboden solcher Räume ist von Beginn der täglichen Arbeit und von Wiederbeginn der Arbeit nach voraufgegangener Pause reichlich mit Wasser zu besprengen und täglich nach Schluss der Arbeit nach reichlicher Besprengung mit Wasser auszukehren. Kehricht, sowie der Inhalt von Sammelbecken in Fussboden ist täglich aus den Arbeitsräumen zu entfernen und in verschlossenen Behältern aufzuheben. Mit dem Auskehren solcher Räume dürfen in der Regel nur Personen beauftragt werden, welche im übrigen bei der Arbeit mit Quecksilber nicht in Berührung kommen. Wo dieses ausnahmsweise nicht ausführbar sein sollte, ist dafür zu sorgen, dass die Arbeiter mit Auskehren häufig, mindestens wöchentlich, abwechseln.

12. Zur Reinigung von Quecksilberabfällen sind, soweit dieselbe in den Beleganstalten selbst und nicht in besonderen Läuterungsanstalten ausgeführt wird, gläserne Scheidetrichter zu verwenden. Die Reinigung quecksilberhaltiger Tücher, Lappen und Anreibeballen ist in gleicher Weise oder durch Auswaschen zu bewirken. Das

Ausklopfen solcher Tücher, Lappen und Anreibeballen ist untersagt, sofern es nicht auf mechanischem Wege in verschlossenen, gegen Staub vollkommen undurchlässigen Behältern ausgeführt wird; auch sind gebrauchte Tücher möglichst häufig durch neue zu ersetzen. Die vorstehend bezeichneten Reinigungsarbeiten dürfen nicht in den Arbeitsräumen vorgenommen werden. In dem Aufbewahrungsraum für Quecksilbervorräte sind sie gestattet.

13. Eine Beschäftigung in quecksilbergefährlichen Räumen darf nur solchen Personen gewährt werden, welche eine Bescheinigung eines approbierten Arztes beibringen, dass nach dem Ergebnis der körperlichen Untersuchung besondere Umstände, welche von der Beschäftigung in einer Spiegelbeleganstalt aussergewöhnliche Nachteile für ihre Gesundheit befürchten liessen, nicht vorliegen. Die Bescheinigungen sind zu sammeln, aufzubewahren und dem nach § 139 *b* der Gewerbeordnung zuständigen Aufsichtsbeamten auf Verlangen vorzulegen.

14. In Beleg- und Trockenräumen dürfen Arbeiter in den Monaten Oktober bis einschliesslich April nicht länger als 8 Stunden, in den Monaten Mai bis einschliesslich September nicht länger als 6 Stunden täglich beschäftigt werden. Nach Ablauf der Hälfte der täglichen Arbeitszeit in diesen Räumen ist eine mindestens zweistündige Pause zu gewähren. Eine anderweite Beschäftigung der Arbeiter seitens des Arbeitsgebers ausser der vorstehend bezeichneten Zeit ist nur dann zulässig, wenn sie nicht in den Räumen erfolgt, welche durch Quecksilberverwendung die Gesundheit der Arbeiter gefährden. Für Anlagen, in welchen Quecksilber-Erkrankungen der Arbeiter häufiger auftreten, kann auf Antrag des nach § 139 *b* der Gewerbeordnung zuständigen Aufsichtsbeamten die Maximalarbeitszeit von 8 resp. 6 Stunden täglich für die Arbeiter in Beleg- und Trockenräumen verkürzt werden.

15. Der Arbeitgeber hat die Ueberwachung des Gesundheitszustandes der von ihm in gesundheitsgefährlichen Räumen beschäftigten Arbeiter einem dem Aufsichtsbeamten (§139 b der Gewerbeordnung) namhaft zu machenden approbierten Arzte zu übertragen, welcher in zwei Wochen mindestens einmal eine Untersuchung der Arbeiter vorzunehmen und den Arbeitgeber von jedem Falle einer ermittelten Quecksilber-Erkrankung in Kenntnis zu setzen hat. Der Arbeitgeber darf Arbeiter, bei welchen eine Quecksilber-Erkrankung ermittelt ist, zu Beschäftigungen bei welchen sie mit Quecksilber in Berührung kommen, bis zur völligen Genesung nicht zulassen.

16. Der Arbeitgeber ist verpflichtet, ein Krankenbuch zu führen oder, unter seiner Verantwortung für die Vollständigkeit und Richtigkeit der Einträge durch den mit der Ueberwachung des Gesundheitszustandes der in gesundheitsgefährlichen Räumen beschäftigten

Arbeiter beauftragen Arzt oder durch einen Betriebsbeamten führen zu lassen. Das Krankenbuch muss enthalten:

1. Den Namen dessen, welcher das Buch führt.
2. Den Namen des mit der Ueberwachung des Gesundheitszustandes der Arbeiter beauftragten Arztes.
3. Die Namen der erkrankten Arbeiter.
4. Die Art der Erkrankung und die vorhergegangene Beschäftigung.
5. Den Tag der Erkrankung.
6. Den Tag der Genesung, oder wenn der Erkrankte nicht wieder in die Arbeit getreten ist, den Tag der Entlassung.

Das Krankenbuch ist dem Aufsichtsbeamten, sowie dem zuständigen Midizinalbeamten auf Verlangen vorzulegen.

17. Der Arbeitgeber hat alle in den durch Quecksilberverwendung gefährlichen Räumen beschäftigten Arbeiten mit vollständigen, möglichst anschliessenden Arbeitsanzuge aus glattem, dichten Stoff ohne Falten und Taschen, mit einer Mütze und mit anliegendem Schuhwerk versehen. Jedem Arbeiter ist eine besondere, für ihn passende Arbeitskleidung zu überweisen. Der Arbeitgeber hat dafür Sorge zu tragen, dass die Arbeitskleider stets nur von denjenigen Arbeitern benutzt werden, welchen sie zugewiesen sind, und dass dieselben nach wöchentlichem Gebrauche stets gereinigt und während der Zeit, wo sie sich nicht im Gebrauche befinden, an dem für sie zu bestimmenden Platze aufbewahrt werden.

18. Ausserhalb der gesundheitsgefährlichen Räume, doch in der Nähe derselben, ist für die in denselben beschäftigten Arbeitern ein nach Geschlechtern getrennter Wasch- und Ankleideraum und getrennt davon, sofern die Arbeiter nicht ausserhalb der Anglage speisen, ein Speiseraum einzurichten. Beide Räume müssen sauber gehalten und während der kalten Jahreszeit geheizt werden. In dem Wasch- und Ankleideraum müssen Gefässe zum Zwecke des Mundausspülens, die etwa ärztlicherseits für erforderlich gehaltenen besonderen Mundspülwässer, Seife und Handtücher, sowie Einrichtungen zur Verwahrung derjenigen gewöhnlichen Kleidungsstücke, welche vor Beginn der Arbeit abgelegt werden, in ausreichender Menge vorhanden sind.

In dem Speiseraume oder an einer anderen geeigneten Stelle müssen sich Vorrichtungen zum Anwärmen der Speisen befinden. Der Arbeitgeber hat den in gesundheitsgefährlichen Räumen beschäftigten Arbeitern Gelegenheit zu gewähren, wenigstens einmal wöchentlich ein warmes oder kaltes Bad (je nach dem Wunsche des Arbeiters oder nach ärztlicher Anordnung) zu nehmen.

19. Der Arbeitgeber hat Vorschriften zu erlassen, welche eine Anweisung hinsichtlich des Gebrauchs der im 17 bezeichneten Bekleidungsgegenstände und hinsichtlich der Vorsichtsmassregeln beim Arbeiten mit Quecksilber für die in gesundheitsgefährlichen

Räumen beschäftigten Personen, namentlich aber folgende Bestimmungen enthalten muss:

(1) Die Arbeiter dürfen Branntwein, Bier und andere geistige Getränke nicht mit in die Anlage bringen.

(2) Die Arbeiter dürfen Nahrungs- und Genussmittel nicht in die Arbeitsräume mitnehmen, dieselben vielmehr nur im Speiseraume aufbewahren. Das Rauchen und Schnupfen im Arbeitsraume ist zu verbieten. Das Einnehmen der Mahlzeiten ist den Arbeitern, sofern es nicht ausserhalb der Anlage stattfindet, nur im Speiseraume gestattet.

(3) Die Arbeiter haben die Arbeitskleider in denjenigen Arbeitsräumen und bei denjenigen Arbeiten, für welche es von dem Betriebsunternehmer vorgeschrieben ist, zu benutzen.

(4) Die Arbeiter dürfen erst dann den Speiseraum betreten, Mahlzeiten einnehmen oder die Fabrik verlassen, wenn sie zuvor die Arbeitskleider abgelegt haben, die Haare vom Staube gereinigt, Hände und Gesicht sorgfältig gewaschen, die Nase gereinigt und den Mund ausgespült haben. Das tragen langer Bärte ist untersagt. Ausserdem ist in den zu erlassenden Vorschriften vorzusehen, dass die Arbeiter im Falle der Zuwiderhandlung gegen die im Abs. 1 bezeichneten Vorschriften vor Ablauf der vertragsmässigen Zeit und ohne Aufkündigung entlassen werden könne.

Werden in einem Betriebe in der Regel 20 Arbeiter beschäftigt, so sind die in diesem Paragraphen bezeichneten Vorschriften in die nach § 134^a der Gewerbeordnung zu erlassende Arbeitsordnung aufzunehmen.

20. In jedem durch Quecksilberverwendung die Gesundheit der Arbeiter gefährdenden Arbeitsraume, sowie in dem Ankleide- und Speiseraume muss eine Abschrift oder ein Abdruck der § 1–19 dieser Vorschriften und der gemäss § 19 vom Arbeitsgeber erlassenen Vorschriften an einer in die Augen fallenden Stelle aushängen. Der Betriebsunternehmer ist für die Handhabung der in § 19, Abs. 1, bezeichneten Vorschriften verantwortlich und verpflichtet, Arbeiter, welche denselben wiederholt zuwiderhandeln, aus der Arbeit zu entlassen.

21. Neue Anlagen, in welchen Quecksilberspiegel belegt werden sollen, dürfen erst in Betrieb gesetzt werden, nachdem ihre Einrichtung dem zuständigen Aufsichtsbeamten (§ 139^b der Gewerbeordnung) angezeigt ist. Der letztere hat nach Empfang dieser Anzeige schleunigst durch persönliche Revision festzustellen, ob die Einrichtung der Anlage der erlassenen Vorschriften entspricht.

22. Im Falle der Zuwiderhandlung gegen die § 1–21 dieser Vorschriften kann die Polizeibehörde die Einstellung des Betriebes bis zur Herstellung des vorschriftsmässigen Zustandes anordnen.

Dass so strenge Vorschriften nicht ohne Einfluss auf die Quecksilberspiegelindustrie bleiben würden, war vorauszusehen, und tatsächlich werden heute fast nur noch ausschliesslich Silberspiegel hergestellt. Es ist dies allerdings nicht allein auf die erlassenen Vorschriften zurückzuführen, sondern zum grössten Teil auch auf den geringen Silberpreis. In Fürth demjenigen Orte, in welchem eine ausgedehnte Quecksilberindustrie betrieben wurde, sind heute nur noch 2 kleine Fabriken in Betrieb, die Quecksilberspiegel herstellen, und zwar für das Ausland.

Für die Herstellung chemischer Präparate aus Quecksilber findet das oben bereits hinsichtlich der physikalischen Instrumente Gesagte sinngemässe Anwendung, und sind ausserdem Räume, wo das Entweichen gesundheitsschädlicher Gase, Dämpfe oder staubförmiger Körper nicht hinreichend verhindert werden kann, so wie Arbeitsräume mit hoher Temperatur mit einem wirksamen Ventilator zu versehen. Ferner ist bei allen chemischen Prozessen, bei denen giftige Gase oder Dämpfe auftreten, Vorsorge zu treffen, dass dieselben in ungefährlicher Weise abgeführt werden können. Mit einigen Worten möchte ich hier noch besonders des Knallquecksilbers (Knallsaures Quecksilber $C_2HgN_2Q_2$) Erwähnung tun. Das knallsaure Quecksilber entsteht durch Erwärmung eines Gemenges von Alkohol, Salpetersäure und salpetersaurem Quecksilberoxyd, es kristallisiert in seideglänzenden weissen Nadeln; beim Erhitzen, sowie durch Stoss und Schlag, auch durch conc. Schwefelsäure, explodiert es äusserst heftig. Man benutzt es hauptsächlich zum Füllen von Zündhütchen, die Anwendung als Schluss- oder Sprengmaterial ist wegen der gefährlichen Handhabung und wegen der enormen zerstörenden Wirkung nicht möglich. Die Rohrwände der Feuerwaffen würden zersprengt werden und nur in kleinsten Ladungen bei Zimmerpistolen und Flobertbüchsen ist die Anwendung möglich. Bei der Fabrikation überwiegt neben der Quecksilbergefahr und anderen möglichen Vergiftungen die Explosionsgefahr und ist hierauf ganz besonders Rücksicht zu nehmen. Die Berufsgenossenschaft der chemischen Industrie hat daher in weitgehenster weise Vorschriften[4] für solche Analgen erlassen, die sämmtlich hier anzuführen zu weit führen würde. Die Vorschriften erstrecken sich auf Umzäunung und Warnungsschilder, Schutzwälle, Schutz mauern, Schutz durch Anpflanzungen, Blitzschutz, Beleuchtung und Heizung der Räume, zulässige Zündsatzmengen, Aufbewahrung und Verarbeitung und Trocknen des Knallquecksilbers, Beseitigung der Abwässer, Vernichtung der Zündsatzabfälle, Vernichtung der Filtertücher, Vernichtung der Ausschuss-Sprengkapseln und Ausschuss-Zündhütchen, Beseitigung des Zündstaubes und Verpackung der fertigen Zündhütchen, Verbot geistiger Getränke, Kleiderwechsel und Verhalten bei Gewitter.

Zum Schluss komme ich zu der Hutstofffabrikation. Für die Hutstofffabrikation werden die Felle der wilden und zahmen Kaninchen und die der Hasen verwandt. Das Fell des zahmen Kaninchen ist meist weniger wert als das der wilden; das beste Material sind Hasenhaare. Die Felle werden im Grossen (en gros) bezogen und kommen zunächst in die Fellzubereitung. Hier werden dieselben der Länge nach (Bauchseite und Rückenseite) aufgeschnitten, die Ohren werden abgeschnitten, sowie Fett und Schmutzflecke entfernt. Die Felle werden dann geglättet, blütige, verklebte Stellen werden mit einem " Ritzer " gelöst. Dann müssen die Nuthen oder Spitzen entfernt werden, es sind dies die langen Haare. Bei den Hasen sind die Spitzen oben dick und unten dünn und müssen mit der Scheere abgeschnitten werden, geschieht aber auch mit Maschinen; bei den Kaninchen ist die Spitze von oben bis unten dick und muss für feinere Sorten mit der Hand herausgerissen werden. Die so vorbereiteten Felle kommen nun in die Beize oder Sekretage. Diese besteht darin, dass die Felle auf der Haarseite mit einer Lösung von Quecksilbernitrat eingerieben werden. Man unterscheidet " gelb " und " weiss " gebeizte Haare. Die gelbe Beize enthält mehr Salpetersäure und weniger Quecksilber, die weisse Beize umgekehrt weniger Salpetersäure und mehr Quecksilber. Die gelbe Beize wird rasch im Ofen getrocknet, die weisse Beize muss langsam trocknen. Nachdem die Felle mit der Beize eingerieben sind, werden dieselben, wie schon aus dem soeben Gesagten hervorgeht, im Ofen getrocknet. Die getrockneten, gebeizten Felle kommen nun auf Bürstenmaschinen, um die Haare zu lockern und alle Unreinigkeiten zu entfernen. Sodann werden die Felle geschoren, was meist mit Maschinen geschieht. Das Haar, welches ganz in der Form und Gestalt des Felles die Maschiene verlässt, wird auf einer Metallplatte aufgefangen und je nach den verschiedenen Körperstellen (Rücken, Seiten, Bauch) sortiert.

Es bleibt sodann noch die Arbeit des " Blasens " übrig. Beim Blasen werden die Haare verschiedener Güte und Farbe in bestimmten Verhältnissen mit einander gemischt und kommen in die Blasmaschiene. Das Haar ist nun für den Hutfabrikanten vollkommen gebrauchsfertig.

Namentlich die Verwendung der giftigen Beize aus Salpetersäure und Quecksilber und die mit Haar- und Schmutzteilen erfüllte Luft in den Arbeitsräumen sind für die Gesundheit der Arbeiter gefährlich; auch ist in allen Arbeitsräumen in der Luft Quecksilber enthalten. Für die Arbeiter und Arbeitsräume finden die für andere Anlagen, in denen Quecksilber verarbeitet wird, bereits angeführten Vorschriften entsprechende sinngemässe Anwendung. Ferner müssen die Arbeiter bei der Beizarbeit über das Handgelenk reichende Gummihandschuhe tragen.

Die Kammern für das Trocknen der Felle müssen so eingerichtet sein, dass die Trockenkammern nicht zum Zwecke des Einhängens der Felle und des Wegnehmens betreten werden müssen. Anlagen, in denen die Trockenkammern mit offenen Koakskörben geheizt werden und zum Ein- und Ausgehen der Arbeiter forwährend offenstehen, so dass nicht nur Quecksilberdämpfe sondern auch Kohlenoxydgase den Arbeitern schädlich werden, sind zu verbieten. Zumal hiervon nicht nur die Arbeiter betroffen werden, die in den Trockenkammern zu tun haben, sondern sämmtliche Arbeiter der benachbarten Räume.

In Deutschland werden die Felle meist ausserhalb der Trockenkammern auf fahrbare eiserne Gestelle gehangen, und die Gestelle sammt den daran hängenden Fellen in die Trockenkammern gefahren, welche mit Dampf geheizt werden. Die Oeffnungen in den Trockenkammern für das Ein- und Ausfahren der Gestelle sind luftdicht abzuschliessen.

Zum Schluss möchte ich noch darauf hinweisen, was Eulenburg in seinem Handbuche der Gewerbehygiene bezüglich der Wirkung des Quecksilbers sagt: "Ganz besonders aber ist noch der nachteilige Einfluss für schwangere Frauen hervorzuheben; alle Erfahrungen stimmen darin überein, dass sie leicht abortieren und tote Kinder gebären."

Ich möchte daher vorschlagen für alle Anlagen, in denen Quecksilber oder quecksilberhaltige Stoffe benutzt und verarbeitet werden, die Beschäftigung verheirateter Frauen zu verbieten; denn es darf wohl angenommen werden, dass eine Mutter, die fortwährend der Einwirkung des Quecksilbers ausgesetzt ist, keine gesunden Kinder bekommen kann. Ebenso wichtig wäre es, das Verarbeiten von gebeizten Fellen, gebeizten Abfällen, Schwänzen und Lunten in der Hausindustrie gänzlich zu verbieten.

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[1] Albrecht, Handbuch der Gewerbehygiene, 1896, S. 116.

[2] Annales d'ygiène publique, 3^e série, v. 8 (1882), p. 262.

[3] Akremninseife hergestellt in der chemischen Fabrik des Dr. C. Zerbe, Allein-Vertrieb durch Petri & Stark in Offenbach a. M.

[4] Die Unfallverhütungsvorschiften der Berufsgenossenschaften der chemischen Industrie. C. Heymann. Berlin, 1912.

L'HYDRARGYRISME DANS LES COUPERIES DE POILS.

Dr. D. J. Glibert, Inspecteur Général du Travail à Bruxelles.

En Belgique, l'étamage des glaces a totalement disparu; à tel point qu'il y est devenu à peu près impossible, même à titre exceptionnel, de faire étamer le plus petit miroir: l'outillage nécessaire et la main d'œuvre compétente font défaut. La dorure au feu est en voie de régression accentuée et la fabrication des lampes électriques à incandescence, au moyen des pompes à vide au mercure, est, dans le royaume, d'une importance secondaire.

Ajoutons que dans les fabriques belges d'explosifs, les ouvriers exposés à l'influence du mercure sont en petit nombre.

D'autre part le sol belge ne contient pas de mines de mercure. Tout l'intérêt de l'intoxication hydrargyrique professionnelle se concentre donc, pour nous, à peu près exclusivement sur l'industrie de la fabrication des matières premières pour chapelleries.

Cette dernière industrie est très développée dans certaines provinces belges et elle y présente des caractères particuliers qu'il n'est point inutile de signaler. C'est donc à ce qui le concerne que nous bornerons la présente étude.

Comme on le sait, les opérations qui ont pour but de fournir à la chapellerie les poils de feutrage dont elle a besoin consistent (1) à fendre, à nettoyer les peaux de lapins et de lièvres (les termes techniques qui désignent ces opérations préliminaires sont: nettoyage, fendage, dégalage, carreletage) ; (2) à arracher (éjarrage) ou à couper (ébarbage) le poil dur impropre au feutrage; (3) à enduire d'une solution de nitrate acide de mercure les peaux en poils ainsi préparées (secrétage) et à les soumettre à l'action de la chaleur dans des fours spéciaux (étuves à secrétage) ; (4) à brosser les peaux à leur sortie des étuves (brossage) et à les livrer à l'action des machines à couper (coupage). Cette action a pour résultat de séparer les poils des tissus sous-jacents, lesquels se trouvent eux-mêmes divisés en fines lanières (vermicelle) que l'on utilise pour la fabrication de la colle de peau.

Contrairement à ce qui se passe dans beaucoup d'usines du continent, les couperies de poils en Belgique comportent presque toutes des ateliers de "soufflage" de poils. Cette dernière opération a pour effet de mélanger intimement les poils coupés; elle constitue la première phase du travail de chapellerie.

Comme on le voit par cet exposé sommaire, les opérations présentent un caractère différentiel très net au point de vue de la morbidité professionnelle: avant le secrétage pas d'intoxication â craindre; après le secrétage ou au cours de celui-ci, danger permanent mais variable en imminence. Les opérations qui précèdent le secrétage sont souvent effectuées à la main dans des manufactures totalement dépourvues de force motrice ou même au domicile de l'ouvrier. Les opérations de secrétage et celles qui le suivent sont toujours effectuées dans des usines, sauf un cas exceptionnel important et qu'il convient de signaler: le coupage à domicile des "chiquettes" secrétées au mercure.

Cette expression technique "chiquettes" demande un mot d'explication. Parmi les déchets de la préparation des peaux en vue du secrétage on rencontre certaines parties: bouts des pattes, queues, etc., qui sont encore garnies de poils utilisables à la condition de subir certaines manipulations spéciales. Ces déchets sont les "chiquettes;" les poils en sont coupés à la main, soit à l'état naturel (veule), soit après immersion dans l'acide nitrique et séchage (secret sans mercure), soit enfin après immersion dans la solution d'azotate de mercure et étuvage ultérieurs (chiquettes secrétées au mercure).

Le visiteur qui pénètre pour la première fois dans un atelier d'éjarrage ou d'ébarbage à la main ne peut se défendre d'une impression pénible. A priori, tout ce qu'il voit, tout ce qu'il éprouve, le pousse à considérer ces ateliers comme insalubres au suprême degré: une odeur peu prononcée mais désagréable vient à sa rencontre dès le seuil; le plus souvent les détails du fond de l'atelier s'estompent d'un brouillard opaque formé d'une infinité de filaments pileux en suspension dans l'atmosphère; les objeta les plus proches, de même que les ouvriers d'ailleurs, sont recouverts d'un épais duvet gris sale qui contribue à donner à l'ensemble un aspect des plus malpropres.

Dans ces conditions il n'est point étonnant que ces ateliers aient, pendant longtemps, été considérés comme particulièrement meurtriers et comme des foyers de pneumoconiose et de tuberculose professionnelle. J'avoue avoir moi-même partagé cette erreur lorsqu'il y a environ 20 ans je commençat l'étude approfondie de l'hygiène des couperies de poils.

Bientôt cependant l'examen détaillé des faits me réserva des surprises, et devant l'inutilité de mes investigations premières j'obtins du Ministre du Travail l'autorisation de faire procéder à une enquête médicale portant sur l'ensemble des travailleurs employés dans ces ateliers.

Cette enquête, conduite avec une scrupuleuse impartialité par des médecins fonctionnaires de l'Etat, lesquels ont, une à une, interrogé et examiné les personnes séjournant dans les ateliers, a démontré le peu de nocuité de ce genre de travail. On en trouvera d'ailleurs la preuve dans les chiffres du tableau qui eccompagne la présente étude, et qui donne quelques-uns des résultats généraux de nos recherches.

En fait, à part certaines lésions irritatives des fosses nasales (plus rarement du pharynx), certaines conjonctivites assez bénignes et parfois certaines otites externes, on ne trouve aucune maladie professionnelle grave qui puisse reconnaître pour cause l'inhalation des poussières dans les ateliers d'éjarrage. A notre avis, cette bénignité relative d'une atmosphère exceptionnellement chargée de poussières et de filaments provient de la nature de ceux-ci qui, longs, flexibles et facilement adhérents, s'arrêtent dans les premières voies et ne parviennent pas à franchir l'isthme du gosier.

En résumé nous pouvons formuler comme suit notre opinion sur les ateliers d'éjarrage et d'ébarbage à la main non spécialement ventilés: ateliers très malpropres, exposant aux lésions irritatives des muqueuses les plus accessibles et des téguments externes, dépourvus de causes exceptionnelles d'insalubrité.

Au surplus l'éjarrage et l'ébarbage à la main sont très fréquemment remplacés par l'éjarrage et l'ébarbage à la machine. Ces dernières sont toujours munies d'un système de ventilation localisée et, dans ces conditions, les ateliers où elles fonctionnent convenablement peuvent être considérés comme des locaux de travail très acceptables.

L'enquête médicale dont nous venons de parler ne s'est point bornée à l'examen des ouvriers employés aux opérations qui " précèdent " le secrétage; tout naturellement elle s'est étendue aux opérations qui accompagnent celuici ou qui le suivent. Voici le relevé général des investigations:

	Nombre de sujets examinés.	État de santé.					
		Bon.	Pour cent.	Médiocre.	Pour cent.	Mauvais.	Pour cent.
Personnel employé aux opérations qui précèdent le secrétage:							
Hommes	705	648	91.91	55	7.80	2	0.28
Femmes	931	784	84.21	146	15.68	1	.11
Personnel employé au secrétage:							
Hommes	88	56	63.64	28	31.82	4	4.54
Personnel employé aux employés aux opérations qui suivent le secrétage:							
Hommes	44	34	77.27	10	22.72	....	....
Femmes	435	300	68.96	126	28.96	9	2.06

Il est facile de constater à la lecture du relevé qui précède, combien est précaire l'état de santé de tout le personnel qui est employé aux opérations qui accompagnent ou suivent le secrétage. Cette dernière opération surtout apparaît comme tout spécialement insalubre. Toutefois, il convient de se souvenir que son personnel se recrute dans la partie la plus malheureuse de la population ouvrière et que, bien souvent, la misère intervient comme facteur très important dans la genèse des troubles morbides qui atteignent cette classe de travailleurs.

Quoiqu'il en soit, l'influence du mercure est absolument indéniable et, dans certains cas, elle détermine des troubles pathologiques des plus graves.

On sait que le diagnostic de l'hydrargyrisme professionnel repose essentiellement sur les constatations de symptômes morbides que l'on peut diviser en deux groupes: ceux qui atteignent le tube digestif, ceux qui frappent le système nerveux.

Tube digestif.—N'insistons pas sur les signes vagues et imprécis, tels que l'anorexie, les digestions difficiles, les vomissements, la diarrhée. La stomatite hydrargyrique professionnelle se caractérise par une tuméfaction et un état fongueux des gencives, un liséré lie de vin ou rouge sale et, bien souvent, des ulcérations assez discrètes.

Contrairement à ce qui se passe dans l'hydrargyrisme thérapeutique, la salivation est plutôt rare; à la longue cette gingivite provoque la chute des dents.

Il est important de savoir que l'on rencontre parfois dans l'hydrargyrisme professionnel, un liséré bleu absolument identique d'aspect au liséré bleu du saturnisme. De même on rencontre des plaques de tatouage bleu à la face intérieure des joues tout à fait analogues à celles du saturnisme.

Il est, au reste, assez remarquable de constater que ce liséré mercuriel n'existe que chez les ouvriers et ouvrières coupeurs, brosseurs et souffleurs de poils. Jamais l'auteur ne l'a observé chez les secréteurs. Ces derniers ouvriers présentent en revanche un stigmate professionnel des plus nets; ce sont les dents noires mercurielles décrites par Letulle. Les dents sont d'un beau noir d'ébène et le revêtement qui recouvre leur émail est entièrement adhérent.

Système nerveux.—L'auteur n'a jamais eu l'occasion de rencontrer les troubles graves de l'intelligence et du raisonnement, la déchéance mentale profonde et la démence paralytique que l'on observe parfois dans les grandes intoxications qui frappent surtout les ouvriers des mines de mercure.

En revanche, chez les ouvriers des couperies de poils, le symptôme le plus fréquent de l'imprégnation profonde de l'organisme par le mercure, c'est le tremblement. On l'observe chez eux à tous les degrés. Certains ouvriers secréteurs observés au cours de l'enquête n'étaient pas moins atteints que les ouvriers des mines de mercure présentés à l'auteur par M. le Professeur Pierrachini dans sa clinique de Florence.

Le tremblement mercuriel est, on le sait, un tremblement intentionnel; des nombreux tracés de ce tremblement enregistrés par les inspecteurs-médecins du travail, il résulte par comparaison, qu'il se rapproche beaucoup du tremblement de la sclérose en plaques, mais avec cette différence qu'il atteint en général d'emblée toute son intensité. tandis que l'autre est à oscillations progressivement croissantes.

On a beaucoup discuté sur la nature du tremblement mercuriel que Charcot considérait comme une manifestation d'un état hystérique; que Raymond et Sicard déclarent être le résultat d'une réaction lymphocitaire, et qu'enfin Lereboullet et Lagave rattachent à une triple influence: toxique, organique et pithiotique (besoin d'imitation).

Les paralysies hydrargyriques sont le plus souvent incomplètes; elles se bornent presque toujours à de la parésie, de l'engourdissement des membres.

Les réactions hématiques de l'hydrargyrisme professionnel sont des moins nettes: elles n'ont rien de caractéristique. Les lésions décrites par Agasse-Lafont et Heim ne sont ni spéciales ni constantes.

Nos observations personnelles ne nous permettent que les affirmations suivantes: la colorabilité, la forme, les dimensions et la résistance à l'hémolyse des globules rouges sont normales; le nombre des globules rouges est diminué.

Le nombre absolu des globules est normal, la formule leucocytaire indique une mononucléose fréquente et parfois considérable, mais on doit se souvenir que cette constatation est banale dans un très grand nombre d'états pathologiques.

Parmi les phénomènes généraux qui surviennent assez souvent à la suite de l'hydrargyrisme, il convient de signaler les complications redoutables d'une néphrite (habituellement parenchymateuse).

Le moyen d'assainissement—la prophylaxie.—Nous ne nous arrêterons pas à énumérer les procédés qui ont été mis en avant pour substituer au secrétage au mercure un procédé moins nocif. Etant donné le prix élevé du mercure, on conçoit que ce problème ait éveillé l'attention de bien des chercheurs; aussi, les brevets pris en vue de l'exploitation d'un "secret sans mercure" sont-ils nombreux. Bornons-nous à cette constatation plutôt fâcheuse: tous les coupeurs de poils déclarent l'usage du mercure indispensable.

Dans ces conditions on ne peut songer qu'à l'emploi de moyens palliatifs. Parmi ces derniers signalons, à titre d'exemple, la mise en usage assez prolongé dans un établissement de Belgique d'une machine à secréter; il est regrettable que des raisons économiques aient fait abandonner l'emploi de ce procédé mécanique qui, au point de vue de l'hygiène, constituait un progrès réel.

On trouvera ci-dessous condensées sous la forme d'un règlement les prescriptions d'hygiène qui ont paru les plus recommandables dans la situation actuelle de l'industrie et de la législation en Belgique. Ce règlement promulgué ces jours derniers sous la forme d'un arrêté royal se caractérise par les points suivants:

1°. En fait, il interdit à domicile les opérations qui précèdent le secrétage, puisqu'il exige, dans les locaux où elles s'effectuent, l'existence d'une ventilation mécanique.

Cette interdiction se justifie par les circonstances suivantes: les opérations dont il s'agit, sans être très insalubres, sont désagréables et sales; il ne convient donc pas de les tolérer dans les locaux d'habitation sans raisons sérieuses. Or, les industriels belges ont unanimement déclarés qu'ils ne s'opposaient point à cette interdiction réclamée avec instance par les divers groupements ouvriers.

2°. Le coupage des "chiquettes" à domicile n'est toléré que pour autant que celles-ci ne soient point secrétées au mercure.

Cette mesure s'explique par les considérations que voici: unanimement les chefs d'entreprise déclarent qu'il leur sera très difficile de se passer du travail à domicile pour le coupage des "chiquettes." Les ouvriers de leur côté ne réclament pas cette interdiction.

D'autre part, il n'est pas admissible qu'on tolère la manipulation de matières toxiques dans les chambres d'habitation et moins encore, comme l'auteur l'a vu, sur la table même où des enfants prenaient leurs repas.

Dorénavant la situation à cet égard sera donc la suivante: la majeure partie des "chiquettes" seront encore coupées à domicile, et l'autre partie, beaucoup moins grande, sera coupée dans les usines, soit à la main, soit au moyen des machines spéciales qui, depuis un certain temps, commencent à se vulgariser.

Toutes des autres mesures prescrites s'expliquent d'elles-mêmes, et il suffit de les énumérer pour en démontrer les avantages hygiéniques.

Notons cependant, avant de donner le texte du nouvel arrêté royal, que la législation sociale belge permet d'imposer l'observance des règles de l'hygiène aussi bien aux ouvriers qu'aux chefs d'entreprises:

ARRÊTÉ ROYAL PRESCRIVANT DES MESURES SPÉCIALES À OBSERVER DANS L'INDUSTRIE DE LA COUPERIE DE POILS.

ALBERT, Roi des Belges.

A tous présents et à venir, Salut.

Vu les arrêtés royaux du 29 janvier 1863, du 27 décembre 1886 et du 31 mai 1887, concernant la police des établissements classés comme dangereux, insalubres ou incommodes;

Vu les arrêtés royaux du 23 avril 1900 et du 5 mars 1912, fixant respectivement les rubriques sous lesquelles les dépôts de peaux ainsi que le travail des peaux et des poils sont inscrits dans la nomenclature des établissements classés;

Vu les arrêtés royaux du 21 septembre 1894 et du 30 mars 1905 prescrivant les mesures générales à observer en vue de protéger la santé et la sécurité des ouvriers respectivement dans les établissements classés et dans les entreprises industrielles et commerciales assujetties à la loi du 24 décembre 1903;

Vu l'avis du Conseil supérieur d'hygiène publique;

Considérant qu'il convient, dans l'intérêt de la salubrité publique et de la santé des travailleurs, de prescrire des mesures spéciales à observer dans l'exécution des travaux prévus sous les rubriques de classement susvisées, indépendamment des obligations fixées par les règlements généraux et des conditions que l'autorité compétente conserve le droit d'imposer dans chaque cas;

Sur la proposition de notre ministre de l'industrie et du travail, Nous avons arrêté et arrêtons:

"ART. 1. Dans l'industrie de la couperie de poils, l'emmagasinage, le nettoyage, le fendage, le dégalage, le carreletage, l'éjarrage, l'ébarbage, le secrétage et le brossage des peaux de même que le coupage et le soufflage du poil, sont soumis aux prescriptions suivantes:

"SECTION I.—*Mesures imposées aux chefs d'entreprise.*

"ART. 2. Les dépôts de peaux, de rognures de peaux (chiquettes), de queues ou de poils, ainsi que tous les locaux où se manipulent ces matières, seront distincts des locaux d'habitation.

"ART. 3. Le chef d'entreprise mettra gratuitement à la disposition des travailleurs un vêtement de travail constitué par une longue blouse s'adaptant bien au cou et aux poignets, une coiffure protégeant convenablement la tête ainsi que les objets de protection nécessaires contre l'action nocive des acides et des instruments de travail.

"ART. 4. Par les soins du chef d'entreprise, les vêtements de travail seront maintenus en bon état et lavés au moins chaque semaine.

"ART. 5. Un local distinct des ateliers servira de vestiaire. Chaque ouvrier y disposera de deux porte-manteaux, l'un pour ses vêtements ordinaires, l'autre pour ses vêtements de travail.

"ART. 6. Indépendamment de ce qui est prescrit à l'article précédent, les ouvriers employés au secrétage ainsi que le personnel occupé aux manipulations de peaux ou de poils secrétés disposeront, dans un local approprié, d'eau salubre de savon et d'essuie-mains propres. L'installation comprendra un verre à boire et un essuie-mains numérotés par ouvrier et une cuvette ou prise d'eau par deux ouvriers.

"Le chef d'entreprise prendra les mesures nécessaires pour qu'avant chaque repas et avant toute sortie de l'établissement les ouvriers visés au premier alinéa du présent article quittent leurs vêtements de travail, se lavent convenablement les mains et la figure, se rincent la bouche et enlèvent la poussière de leurs cheveux.

"ART. 7. Un local servant de réfectoire sera tenu à la disposition des ouvriers qui prendraient leurs repas à l'établissement. Ce local sera distinct des ateliers; il contiendra des tables, des chaises et un appareil pouvant servir à réchauffer les aliments.

"ART. 8. Les installations hygiéniques visées aux articles 5, 6 et 7 seront maintenues très propres, en bon état, bien ventilées et chauffées à une température de 18 degrés au moins.

"ART. 9. Il est interdit: 1° d'employer des ouvriers s'adonnant à l'ivrognerie; 2° de laisser introduire dans l'établissement des boissons alcooliques distillés; 3° de laisser déposer des aliments, manger ou boire, ailleurs qu'au réfectoire.

"ART. 10. La préparation et la conservation des solutions destinées au secrétage seront effectuées de manière à éviter que les vapeurs acides puissent incommoder les ouvriers.

"ART. 11. Les ateliers de secrétage seront munis d'une ventilation mécanique localisée aspirant les vapeurs acides aussi près que possible de leurs lieux de production.

"Le revêtment des murs de ces ateliers jusqu'à hauteur d'homme, le sol et les tables à secréter seront imperméables et nettoyés à grande eau au moins une fois par semaine.

"ART. 12. Les étuves destinées au secrétage ne pourront communiquer directement avec les locaux de travail et les mesures voulues seront prises pour que les vapeurs qui s'y produiront ne puissent se répandre dans ces locaux.

"Les étuves seront pourvues d'un dispositif tel que l'ouvrier ne soit pas obligé d'y pénétrer pour introduire ou retirer les peaux.

"Il est interdit de laisser pénétrer les ouvriers dans une étuve de secrétage insuffisamment ventilée.

"ART. 13. Tous les locaux dans lesquels s'effectuent les opérations qui précèdent le secrétage et ceux dans lesquels se manipulent les peaux, les rognures de peaux (chiquettes), les queues et les poils après le secrétage au mercure, seront pourvus d'une ventilation mécanique efficace.

"Pour le brossage des peaux secrétées, on installera, en outre, une ventilation mécanique localisée au lieu de production des poussières.

"Les dispositions du premier alinéa du présent article ne sont pas applicables aux locaux où se pratique exclusivement le coupage à la main des chiquettes, rognures et queues non secrétés au mercure.

"Art. 14. L'air ayant parcouru les machines à souffler le poil secrété sera évacué directement à l'extérieur.

"Art. 15. Le personnel employé à la préparation du secret, au secrétage et à la manipulation des peaux ou des poils secrétés, sera examiné trimestriellement par un médecin agréé par le Ministre de l'Industrie et du Travail. Les frais de ces examens, tarifés par arrêté ministériel, incombent aux patrons.

"Les ouvriers atteints d'hydrargyrisme seront écartés des travaux qui exposent à l'empoisonnement. Il en sera de même de ceux dont l'état général serait mauvais au moment de l'examen.

"Il sera tenu un registre spécial, conforme au modèle délivré par l'administration, sur lequel le médecin agréé consignera les constatations faites au cours de ses examens.

"Ce registre sera remis aux agents de l'autorité à chaque réquisition.

Section II.—*Mesures imposées aux ouvriers.*

"Art. 16. Les ouvriers devront faire usage des vêtements de travail mis à leur disposition ainsi que des objets de protection nécessaires contre l'action nocive des acides et des instruments de travail.

"Art. 17. Les ouvriers ne pourront déposer leurs vêtements qu'au vestiaire.

"Art. 18. Avant chaque repas et avant toute sortie de l'établissement, les ouvriers employés au secrétage de même que le personnel occupé aux manipulations de peaux ou de poils après le secrétage sont tenus de quitter leurs vêtements de travail, de se laver convenablement les mains et la figure, de se rincer la bouche et d'enlever la poussière de leurs cheveux.

"Art. 19. Dans les établissements soumis aux prescriptions du présent arrêté, les ouvriers ne peuvent déposer des aliments, manger ni boire, ailleurs qu'au réfectoire.

"Il est interdit aux ouvriers d'introduire ou de consommer dans ces établissements des boissons alcooliques distillées.

"Art. 20. Les ouvriers sont tenus de se prêter aux examens médicaux prévus à l'article 15 du présent arrêté.

Section III.—*Dispositions générales.*

"Art. 21. Les articles 3, 4, 5, 7, 17, et 19 ne sont pas applicables aux travaux effectués exclusivement par les membres d'une famille occupant la même habitation.

"Art. 22. Les chefs d'entreprise sont tenus de faire afficher dans leurs ateliers, à un endroit apparent, les dispositions du présent arrêté.

"Art. 23. Les inspecteurs du travail et les délégués à l'inspection du travail sont chargés de surveiller l'exécution du présent arrêté.

"La constation et la répression des infractions auront lieu conformément à la loi du 5 mai 1888, relative à l'inspection des établissements dangereux, insalubres ou incommodes.

"Art. 24. Notre Ministre de l'Industrie et du Travail est chargé de l'exécution du présent arrêté qui entrera en vigueur trois mois après sa publication au *Moniteur*."

Donné à Clergnon, le 10 août 1912.

Albert.

Par le Roi:

Le Ministre de l'Industrie et du Travail,
Arm. Hubert.

LEAD POISONING IN THE UNITED STATES.

Dr. Alice Hamilton, Hull House, Chicago, Ill.

When one tries to compare the lead industries of the United States with those of any European country, in respect to the incidence of lead poisoning among the workmen, one is confronted with the lack of statistical information in our country, and the comparison can not be made with any real completeness except in the case of a few trades which have been intensively studied by the Federal Bureau of Labor. There are, however, some broad comparisons which can be made and which show that in certain respects the United States has the advantage over European countries, and that, in other respects, the reverse is true.

To speak first of the points in which the advantage is on our side, I may mention some industries which give rise to lead poisoning in European countries, but, owing to differences in the processes used, are quite harmless in the United States. File making and jewel polishing are notoriously dangerous trades in Europe. They are not lead trades here. The making of cheap kitchen ware is a bad lead trade in England. Our ware is made of iron covered with an extremely thin coating of tin, not of lead and tin. Our cut glass is rarely polished with putty powder containing red lead, because the more rapid process of finishing with hydrofluoric acid is taking the place of that. The fact that lead pigments are relatively expensive has led to a search for cheap substitutes, and we find a very general use of aniline greens and yellows instead of cromate of lead in American textile works, paper factories, and in the making of artificial flowers. As for lead paints, graphite is used more and more to cover metal surfaces in place of red lead, and it is probable that lithopone and sulphate of lead often mask as lead carbonate in mixed paints, but as to this it is hard to speak authoritatively. In the rubber trade it is admitted that lead carbonate has been largely abandoned for the less poisonous sulphate. Whatever may be felt as to the effect of such substitutions on the value of the product, there can be no doubt that the producer—the workman—profits greatly by the use of relatively nonpoisonous substances in the place of poisonous.

On the other hand, there are lead trades which are distinctly more dangerous in the United States than in Europe. In our railway, coach, carriage, and automobile factories there is a great deal of rubbing with sandpaper in order to prepare the already dry coat of lead paint for the reception of the second coat. This work is often done in closed rooms and no attempt is made to draw off the poisonous dust. Our white lead industry is attended with dangers such as do not exist in the same industry in Great Britain and Germany, although the process used here can be seen also in Belgium. Another industry more dangerous here than in England is the making of storage batteries, or electrical accumulators. In all such factories that I have visited in the United States a mixture of oxides of lead and other ingredients is given in dry form to the workmen, each of whom must make up his own paste. In the British factories I visited the paste was made in the mixing room and given out to the workmen. The comparative freedom from dust of the English method is obvious.

It is probably true that in some of the lead trades living conditions are better here than in the same trades in Europe. The potters in New Jersey and Ohio who belong to the organized branches of the trade consider themselves as better off than their relatives in Staffordshire. The Slavic enamelers in the sanitary ware factories of Pennsylvania, Illinois, and Wisconsin live better than they did in Austria-Hungary. On the other hand, the lead smelters, with the exception of the open hearth men, are usually non-English-speaking, nomadic foreigners, poorly paid and wretchedly housed. A comparison between a large smelting plant in southern Illinois and one in Ems would show that the German workman is better off in every respect than the American.

Ignorant and more or less neglected foreigners also man our white-lead works and storage-battery works, and swell the ranks of the unorganized painters and printers, who take employment in the worst of the workshops and have the more dangerous kinds of work to perform. They are the painters who are found sandpapering dry white-lead paint in railway and carriage shops; they are the printers who found and set type by hand in tiny, dirty printing shops.

The presence of these groups of non-English-speaking foreigners in many of our lead trades gives rise to a condition which is not found, so far as I can ascertain, in any lead trade in Great Britain, though apparently it exists and is recognized as a danger in some of the remoter lead-smelting works in Germany. To illustrate it I might describe a large lead-smelting plant in southern Illinois. With the exception of a small number of skilled American workmen, this place is manned by Greeks, Macedonians, Bulgarians, a few Slavs from Austria-Hungary, and by negroes. The men are housed in filthy shacks, and are poorly paid. In consequence they are so shifting a body of workmen that it is sometimes necessary to arrange beforehand with the employment agencies of Chicago and St. Louis for almost 50 per cent of new men to take the place of those who will leave on the semimonthly pay day. Up to 18 months ago there was no law compelling the owners to do anything for the protection of their men against lead poisoning, and, naturally, neither employers nor foremen took much interest in a gang of foreigners whose very names they did not know, and whom they expected to lose in a few weeks' time. To trace cases of lead poisoning among these men was impossible. A sick man might go to the nearest doctor, who would make no attempt to learn his name or address; or he might land in a hospital in St. Louis, where they would not trouble to ask where he had been working; or he might go up to Chicago to find a doctor of his own nationality; or join a railway gang in the far West, in the hope of regaining his health in outdoor work. Nobody knew what became of him. Between him and the prosperous American town, a mile or so away, there was absolutely no connecting link, except a long line of saloons with foreign names over the doors.

Even if the community is a stable one, the fact that it is foreign adds greatly to the difficulties of an investigation and undoubtedly to the difficulties of an employer who wishes to enforce hygienic measures. In a certain white and red lead factory, practically 90 per cent of the employees are Poles and Italians. It is impossible to verify a case of reported lead poisoning among these Poles. Their rooted suspicion of all governmental supervision leads them to conceal even their names and to instinctively cover up their tracks. They will give one name to their foreman, another to the hospital, and their real name will be known perhaps only to the family and the priest. Italians are not so suspicious, yet they, too, are hard to trace. A man who is known as Dago Jim in the factory may be Vincenzo Cosenza to the neighborhood, because he came from Cosenza, while the hospital record will have his real name, Vincenzo Perrone.

The greatest disadvantage, however, from which the lead industries in the United States suffer, as compared with the same industries in Europe, is the almost total absence of laws governing the hygiene of the lead trades. This does not mean that all our factories in which lead is used are more dangerous than are the European factories, for in many instances benevolent employers have tried, and, in a few instances, employers at once benevolent and intelligent have succeeded in so constructing and managing their works as to bring them up to European standards. But while some American factories are larger, better constructed, and more lavishly equipped than any I have seen in Europe, the evils arising from the lack of industrial legislation are seen in a large number of factories, which are poorly constructed and carelessly managed to a degree that would not be tolerated in Europe. Even in those which are under careful, conscientious supervision, one sees evidences of the need of expert direction, such as can only be given by men versed in industrial hygiene.

In this brief review of the lead trades in the United States, as compared with the same trades in Europe, the impression must be left on your minds that such advantages as we possess, in the way of higher wages, where these exist, and the comparative absence of women and young people, are more than offset by the great disadvantages which come from the employment of non-English-speaking, nomadic workmen, at a low wage, and from an almost total lack of legislative control of these industries. That this impression is correct, that we have more lead poisoning in the United States than is to be found in the corresponding industries in Europe, is apparently true of the three lead trades which have been intensively studied by the Bureau of Labor.

In two of these, the white-lead industry and the making of porcelain-enameled sanitary ware, we have to do with industries in which the processes used here are decidedly more dangerous than those used in most European factories. In the making of old Dutch process white lead the American method is to separate the carbonate from the uncorroded lead by grinding, crushing, and screening it dry, and therefore we can not wet down the white beds before stripping, as is required by law in England and Germany. It follows that stack stripping and the conveying and separating of cores and corrosions is much dustier work in an American factory than it is in a British or a German factory. Besides this, we dry our final product, the suspension of white lead in water, in great open tanks, and the dry powder is shoveled from these tanks and thrown into open wagons. This work is recognized everywhere as very dangerous, and efforts are made in several plants to control the dust, but the very best of these is not as safe as any of the English and German factories I have visited. It would not be fair to give the figures from the bureau reports as to lead poisoning in this industry, for during the months that have elapsed since its publication, great improvements have taken place in white-lead works, and it is probable that lead poisoning has diminished remarkedly.

It is harder to compare the second industry, the making of porcelain or vitreous-enameled sanitary ware, in the United States with the same industry in Europe. In Germany this is not a lead trade at all. German cast-iron sanitary ware is covered with a leadless enamel. In Great Britain this is also true in many factories, and though it was not easy to learn very much about this particular trade, yet it is certainly true that the making of this ware is not a dangerous lead trade in Great Britain. The report of the chief inspector of factories and workshops for 1910 gives only 17 cases of lead poisoning in workers in vitreous enameling plants during this year, and from interviews with inspectors, I learned that by far the greater number of these people were not employed in sanitary ware establishments, but in the making of signs.

In the United States this is a large industry. The 10 plants which were investigated by the Bureau of Labor employ over 1,000 mill hands and enamelers on their regular force, and many more in the course of the year, for the mill hands are unskilled laborers, who shift all the time. Out of 45 who were questioned only 16 had worked more than a year. Even the enamelers, skilled workmen, employed for shifts of never more than eight hours, often only six, and well paid, do not remain long in the trade; 250 of them averaged only six years' employment.

The reason for this is easy to understand, for it is an occupation which makes tremendous demands on physical endurance. For those who are not familiar with this sort of work I will give a short description of it as it is done in all American and in some British factories. I saw the same processes in an Austrian factory where porcelain-enameled gas stoves are made.

The enamel used is essentially a ground glass containing anywhere from about 2½ to 20 per cent of soluble lead by the Thorp test, according to the report given by the Government Bureau of Chemistry. The mixing of this enamel is dangerous work, and is done by unskilled foreigners or negroes under the direction of a chemist. Some of these laborers know they are working with poisonous stuff, because they have seen men who were affected by it, but others are quite ignorant of the risks of the work.

The men who apply the enamel are skilled, well paid, and intelligent men. They work usually in large, well-ventilated rooms, and rarely more than eight hours a day. The bath tubs, sinks, basins, and so forth, which are to be covered with enamel come from the sandblasting department to the slushers, whose duty it is to paint them over with the slush or ground coat. If the room in which this is done is separate from the enameling room, the work is harmless, for the ground coat is liquid and has only traces of lead, if any, but generally the slushers work at one end of the enameling room, or in a room opening directly out of it, and full of enamel dust. After the ware has had the slush coat, it is handed over to the enameler and his helper, usually a grown man, who puts it into the furnace until it is red hot, then it is brought out and placed on a turning table in front of the furnace door. The helper turns the ware at different angles, while the enameler shakes over it the powdered glaze from a dredge. This process of heating and enameling must be repeated several times, the ware being returned to the furnace after each coat, and then brought out for another coat. Large ware must remain several minutes in the furnace, and in this interval the men can go over to the windows to cool off or sit down and rest. Work on small ware is more nearly continuous, for it is heated more quickly, and it is a question among the men which is the dustier and more strenuous task. On the one hand, small ware does not take so much enamel.

nor so much strength to handle, but, on the other hand, there are many more pieces to be done.

In putting on the first coat, the enameler can stand at a distance from the ware, about 4 feet from the small, and 7 or 8 feet from the large ware, but the last coat must be put on very carefully, so that no uneven places shall remain, and for this the man must come up closer, as close, indeed, as the heat permits. After the ware is done, it is gone over by an especially skillful enameler who looks for the defective spots, and these men may sometimes be seen dusting enamel by hand over imperfectly covered ware.

Illinois is the only State which requires, in establishments using dry-lead enamel, any precautions for the care of the men other than those required in ordinary workshops. The men in the mixing rooms, mill rooms, and enameling rooms have no place to hang their street clothes away from the lead dust, and no place to keep or eat their lunch. Several times the wives of these men spoke of finding the white dust in their husbands' lunch boxes. The mill men may go out into the yard for lunch, or go home, but the enamelers are doing piecework, and lose money if they stop work to eat. Moreover, the furnaces are running continuously, and the men are not expected to let them run at a loss to the factory. The managers who were interviewed said that the men were supposed to work steadily during the six or eight hours of their shift, except for the necessary pauses while the ware was heating. Consequently, the men either eat no lunch at all, many saying that the heat or the enamel destroys their appetite, and that they do not care for lunch, or they take a bite now and then while the tubs are heating. I have often seen a man open his lunch box and take out some food while the ware was heating, lay down his sandwich anywhere (there is no dust-free place), go back to his work, and then return in a few minutes to finish eating. Of course, washing the hands and face before lunch is out of the question, because there is no time for it. In some factories the drinking water stands in open pails in the enameling room.

The men who handle small ware do not have to make great physical efforts to get it in and out of the furnaces, but the bathtubs require all the men's strength, even with the help of the mechanical appliances now found in all factories. The excessive heat is exhausting, especially in summer, and the men's wives speak of their husbands coming home on warm days weak, exhausted, and soaking wet. In some factories the hours are shortened in summer, and four shifts are employed instead of three, in order to spare the men and to increase the output, but in other factories the long shift comes during summer and the short shift is introduced in winter, when the work is slack.

The elements of heat and overfatigue in this trade bid fair to grow worse rather than better, because of the introduction of double furnaces in place of the single furnaces. These furnaces are kept at a somewhat lower temperature, so that the enamel does not fuse quite so quickly, and one man can tend both, for while he is dredging enamel on one piece of ware the other is heating, and by the time the first is ready to go into the furnace the second is ready to come out. This makes the work practically continuous. There are no intervals here for strolling to the windows to get a breath of air or sitting down to rest. Even when the hours are shortened from eight to six the man on the double furnace finds his work more exhausting than it was on the single. It is said that the adoption of these double furnaces will probably be general.

To summarize, then, we have in our sanitary-ware factories men working in great heat, subject to excessive physical strain, and exposed for the larger part of their six or eight hours' shift to clouds of dust which contain soluble lead. It is easy to see that this is a very dangerous lead trade. The full amount of injury for which the enamel dust is responsible will not be known until a study has been made of pulmonary tuberculosis among these men, as well as of lead poisoning, but so far we have information only about the latter. The figures I give were gathered, as such information must be, in cities where there is no legal requirement for physicians to report cases of lead poisoning, and where the working class is composed largely of more or less shifting Slavic immigrants. Hospital records and physicians' notebooks yielded, for the year 1911, records of 191 cases of lead poisoning in a force of 1,012 men, or one for every five men employed. That this number falls below the truth, that the proportion of men with evidence of plumbism is even greater than this, was shown by the physical examination of 148 men who were out on strike, but who had been working up to a few days before the examination was made. Fifty-eight of the 148 had positive symptoms of chronic plumbism and either the blue line or extreme gingivitis obscuring the line; 15 had characteristic symptoms, but no line; 19 had a well-marked line, but either denied ill health or had symptoms not entirely typical. Only 56 had no line and no definite symptoms. There were, therefore, 39 per cent of positive cases and 38 per cent of negative, with 23 per cent suspicious. These men averaged a little over five years' employment; they were all Slavs, many of them powerfully built peasants who had not known a day's sickness until they entered this trade.

The form which lead poisoning takes among these enamelers is sometimes very severe. Out of 177 case histories which were obtained there were 28 cases of palsy and 8 of encephalopathy. The mortality from lead poisoning, as reported by physicians, averaged for two years 3.4 per 1,000 employed, which is more than three times as great as the mortality among English potters.

The rapidity of poisoning is not as great among enamelers as among men engaged in making white lead. Of 120 cases of lead poisoning in the latter industry 89 men, or 74 per cent, had worked less than one year. Among 94 cases in bathtub enameling only 48 per cent had worked less than one year.

The one English sanitary-ware factory in which I saw this sort of work done with a similar enamel employs 24 men in the mill room and as enamelers. The records of the physician who examines these men once a month show that they average one case of lead poisoning in two years' time. I hesitate to make a comparison on the basis of this one factory, and yet there must be some reason for the great contrast between these figures and those given above. Perhaps I might select as a fair basis for comparison a group of 21 enamelers and mixers from one of the two American factories mentioned above where the men were out on strike. A physical examination of these 21 men showed evidences of chronic plumbism in 7, 4 more had the lead line, 4 were in ill health dating from the beginning of their employment, 6 only were positively free from any sign of lead absorption. In other words, the English factory has one case in two years among 24 men, while the American factory has at least 7 in one year among 21 men.

It is probable that the difference between the American and the English factories is not to be found in the proportion of lead used to make the enamel, but in the sanitary control exercised over the men. The English mill hands and enamelers are given proper working clothes, caps, face cloths, and every facility for personal cleanliness, and are obliged to avail themselves of these provisions. They are given time for lunch and are required to wash before they enter the lunch room, the only place where they may keep or eat food. Once a month a physician examines each one for signs of lead absorption. The American workman is not given any of these safeguards. No working clothes or caps are provided, the men usually make a complete change from their dusty clothes when they leave work, but this is not always true. Some of the foreign workmen are said to wear their shirts home, if not their trousers, and in one plant which was visited on a very cold day the helpers were boys between 14 and 16 years of age, who were wearing good new sweaters at work, and there is no doubt that these same sweaters were worn in the street and at home.

If a physician is attached to the factory he is summoned only for accidents, or in case a man is seized with severe colic or convulsions while at work.

The pottery industry is the third lead trade which has been investigated by the Bureau of Labor. It is not as important an industry in our country as are the ceramic industries of Great Britain and of Germany. While in the former 6,865 men and women are engaged in occupations exposing them to lead, only 1,500, less than one-quarter, are employed in the American potteries which were investigated by the Bureau of Labor, and which represent over three-fourths of the industry. Pottery making came to the United States from Staffordshire, and is still a trade ruled by English traditions and manned by men of British birth or parentage. This fact has had its influence upon the sanitary control of the trade. The Staffordshire men, who are potters, foremen, and employers in the United States, remember the industry as it was in England when they learned it in their boyhood, and, knowing as they do, that their potteries in New Jersey and Ohio are a vast improvement over the Staffordshire potteries of several decades back, they refuse to believe that there is anything wrong with the trade in this country, or that lead poisoning can be nearly as serious here as in England. They have not kept up with the improvements which have taken place in England, and have no idea how far they are lagging behind the old country.

Yet, with less than one-quarter of the working force, our American potteries have almost twice as many cases of lead poisoning in a year's time as have the British potteries. In 1910, Great Britain had 77 cases in a force of 6,865; in 1911, we had 144 cases in a force of only 1,500. The figures for Great Britain are 1 man poisoned out of 112 employed; for America, 1 man out of 12 or 13; for Great Britain, 1 woman out of 63 employed; for America, 1 woman out of 7.

Although the number of cases of lead poisoning is much greater in this country, yet apparently the more serious forms of the disease are not so frequent here as in England, and this may be one reason for the popular belief that lead poisoning is worse in Staffordshire than in Ohio and New Jersey. Cases of encephalopathy are rare, except in the tile works, and cases of blindness almost unknown. The mortality from lead poisoning is less than one per thousand. Dr. T. M. Legge has classified the cases of lead poisoning among British potters for five years according to the severity of the disease. If we follow his scheme, an analysis of 86 histories of male cases in American potteries would give only 8 per cent of the severe form as compared with Legge's 19 per cent. The female cases, however, correspond more closely to the English.

British authorities insist that there is a true sex susceptibility to lead poisoning, that women are more prone to it than men, and that they are more likely to have the severer nervous manifestations. The cases of encephalopathy found in this investigation among pottery workers confirm the latter statement, for 9 out of 14 collected cases and all of the 3 fatal ones were women. At first sight it would seem that the results of the investigation bear out also the statement that women are more susceptible to lead poisoning than men, for there were 57 cases among 400 women, or 1 to 7, and only 87 among 1,100 men, or 1 to 12 or 13, but a closer analysis shows that there are factors influencing this difference other than the factor of sex.

In East Liverpool and Trenton, the relative proportion of male and female cases is even more strikingly in favor of the men than is the proportion given in the British reports; 795 men had 39 cases, which is 1 to every 20 or 21, and 150 women had 29 cases, or 1 to every 5 or 6 employed. But these are the districts where white ware is made; that is, table and toilet ware, and sanitary earthenware, and the men employed in these branches are strongly organized. As compared with the men, the women here have many handicaps aside from that of sex idiosyncrasy. They are unorganized, poorly paid, poorly housed and fed, subject to the worry and strain of supporting dependents on a low wage, fearful of losing their employment, while the men are prosperous and independent. In the unorganized pottery fields, however, in the tile works and art potteries, men and women are in the same economic class, all making low wages with everything that that implies, and here no such disproportion is found in the incidence of lead poisoning in the two sexes. In the establishments that were studied there were, in 1911, 305 men employed, and there were 48 cases of lead poisoning, or 1 for every 6 to 7 men. Two hundred and forty-three women were employed, with 28 cases, or 1 for every 8 or 9. The ratio is actually greater among the men. Of course, I offer these figures very tentatively, for I know that they can in no way be compared with the British reports, which are based on a medical examination of all men and women employed, and on accurate records as to the number of employees during a year. My results can only be suggestive. I give them because the contrast between the proportion of male cases in the unionized branches of the trade and that in the nonunionized branches seems too great to be accidental.

One reason for the discrepancy between these results and the British statistics may be found in the fact that many of the lighter cases of plumbism in women and girls were not reported to me by physicians. I was told by some of them that while they saw more men with the typical gastric form of lead poison, they saw large numbers of women and young girls with less pronounced and characteristic symptoms, which were probably, they supposed, attributable to the lead, such as profound anemia with constipation, and sometimes amenorrhea. It is more than probable that many of these cases were not reported to me, for the majority of physicians hesitate to speak of lead poisoning if there is no colic. The British reports, however, include just this class of cases: "Anemia of adolescence aggravated by employment."

I have had to limit my comparative study of the ceramic industry here and in Europe to one European country—Great Britain—because, though I have visited potteries in Germany and Austria, I have not been able to find statistics in those countries which would make it possible to state how large a proportion of the men and women exposed to lead in ceramic work suffer from plumbism. Austria has no compulsory notification of industrial lead poisoning. Prussia does not require it in this industry. Saxony does, but has not the system of periodical medical examinations of all lead workers as Great Britain has. Consequently, the cases reported in Saxony represent only the persons who voluntarily consult the sickness-insurance physicians. Moreover, there are no data available in Germany as to the number of ceramic workers who are exposed to lead, and therefore it is not possible to ascertain, even in Saxony, whether the number of cases of lead poisoning reported during one year from this industry represents a very small or a moderate proportion of the people employed. German experts assure me that the very lack of supervision of this industry shows that the amount of lead poisoning must be small; otherwise the attention of physicians would be called to it and a Government inquiry instituted. However this may be, it is not possible at present either to prove or to disprove such a statement.

One pottery I visited—the Dresden branch of Villeroy & Boch—has a very excellent record, as far as industrial plumbism goes. There are 200 persons regularly employed here in occupations exposing them to lead, and 15 more who work four or five weeks twice a year making up the glaze. During the last four years no case of lead poisoning in this factory has come to the notice of the sickness-insurance physicians.

As for the influence of sex, the general impression among the Germans who discussed the question with me was that there is relatively more lead poisoning among men in the ceramic trades than among women doing similar work.

The great falling off of industrial plumbism among British potters during the last decade is easy to understand when one visits English potteries and tile works. To a less extent is this true of the German potteries, which are usually larger and better constructed than the English, but in which one does not find the scrupulous attention to detail, the skillful devices for the prevention of glaze dust, and the strict supervision of personal cleanliness that are found in British potteries. American potteries are, for the most part, large, well lighted, and ventilated, but the workmen are not protected from lead dust. British regulations prescribe floors of impervious material, which are flushed with water at the end of the day's work; the German and Austrian potteries that I visited have these also. American dipping rooms have wooden floors, worn rough, white with accumulations of glaze dust, almost never washed, and swept after a perfunctory sprinkling by girls or boys at the end of the day's work. British regulations require the employer to provide working clothes and caps; many German and Austrian employers do the same; no American does. European potteries are provided with lunch rooms away from the lead dust. I have never seen one in an American pottery or tile works, but I have seen many lunches eaten in the dipping rooms. Hot water, soap, towels, and nail brushes are provided by all British and by some German and Austrian pottery owners for the workers exposed to lead, but never by Americans. Even more disastrous is the carelessness as regards glaze dust in our potteries, especially in our tile works, where practically no attempt is made to minimize the dangers caused by dry glaze. In this respect the British potteries are admirable—better than the best German. It is needless to say that no American pottery owner thinks of having regular medical inspection of his work people.

If these drawbacks are somewhat offset in our white-ware potteries by the high rate of wages paid to the men, there is no such compensation for the women workers in white ware, nor for the men and women in majolica and yellow-ware potteries, and in tile works, where the rate of wages is extremely low.

I feel that I have been drawing a dark picture of American industry, and, indeed, it is hard to touch upon the subject of industrial hygiene without prevailing our striking neglect of this field of preventive medicine. I do not believe it means that we are harder hearted than Europeans, more indifferent to the fate of our working people. I believe it means only that we are vastly more ignorant. Ten years ago we knew practically nothing about the morbidity of our dangerous trades; now we are slowly beginning to learn, and the greatest need in the country at present is more knowledge on the subject. That action will follow fairly promptly upon such knowledge was shown by the passage of legislation on the use of poisonous phosphorus within a short time after the condition in our match factories had been made public. Another proof of our readiness to act was given by Illinois, which, within a few weeks of the appearance of her industrial diseases report, passed a law framed on British models for the control of occupations involving the handling of poisons, a law which met with no opposition from the owners of the great lead-smelting, white-lead, and dry-color establishments in Illinois.

The fact that such legislation is a matter for the separate States, not for the Federal Government, is sometimes looked upon as an obstacle, because it means placing some manufacturers under restrictions to which their competitors are not subject; yet, in another way, this is an advantage, for one State may venture upon experiments in legislation which the country as a whole is not yet ready to try. It is to be hoped that Illinois will be able to show the other States of the Union that laws controlling the poisonous industries are a benefit, not only to the workmen, but to the industry itself.

INDUSTRIAL LEAD POISONING AND SOME OF THE PROBLEMS IT RAISES.

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In my own country the workmen's compensation act has given a fresh impetus to the study of industrial lead poisoning, but more especially to latent plumbism and to the less well-known forms of the malady. As an affected workman is entitled to compensation, the burden is thrown upon him of proving that he has contracted lead poisoning. The liability for the malady rests upon the employer in whose service the workman was last engaged during the 12 months previous to the development of the illness. As such a workman may have been employed in more than one factory during that period, the workman must furnish to the aggrieved employer the names and addresses of all employers with whom he worked during the particular 12 months, since for lead poisoning, which is a disease of gradual development and the date of its onset unknown, the liability has to be divided between various employers.

Where such symptoms as colic, vomiting, constipation, blue line on the gums, headache, and cachexia are present, accompanied or not by wrist drop, the diagnosis of plumbism is comparatively easy. The difficulty commences when there is a limited nerve disorder, such as muscular paresis, atypical brain symptoms, and a sense of malaise which is badly defined, where there is continuous headache, with or without albumin in the urine, no blue line on the gums, or only a doubtful one, and where no history of exposure is obtainable. Any assistance toward a diagnosis is welcomed. Several physicians are of the opinion that in basophile degeneration of the red blood corpuscles is to be found an important sign of plumbism. Basophilia to the extent of anything above 1 per cent is held to be characteristic of lead poisoning.

I can not say that I have found basophilia to be the assistance in diagnosis which Grawitz and other writers claim for it; nor is it a ready method, since it requires a certain amount of technical skill in the preparation of the blood film and familiarity with the microscopical appearances of the blood, which busy practitioners of medicine do not always pretend to have. In a rabbit which took lead almost daily for nearly three years, I found no basophilia, nor did I find it present in the blood of a woman who nearly lost her life through having taken a large number of diachylon pills in order to procure abortion. Basophilia was present to the extent of 1 in 500 erythrocytes, or only 0.2 per cent, in another woman who nearly killed herself with diachylon pills, having in the course of a few days taken 144 grains of oleate of lead. In by far the largest number of my patients, basophilia was neither a constant nor a striking phenomenon; besides, it occurs in other diseases than plumbism. I consider the presence of lead in the urine to be of more assistance, from a diagnostic point of view, than basophilia, for although, like the blue line on the gums, lead is found in the urine of persons who do not exhibit symptoms of plumbism, yet its presence can not altogether be ignored. If the significance of the Burtonian line is that lead is present in the system, the finding of lead in the urine means that it is being eliminated. Lead because stored up in the body only when elimination fails to keep pace with absorption. On examining the urine of several lead workers, who at the time were following their occupation, lead was found in the urine of nearly all of them and, although most of the men were pale and did not look well, not one of them was ill. Within a few months two or three of these workmen were admitted into the infirmary under my care, some of them seriously ill with lead poisoning. Although where a blue line exists on the gums and lead is present in the urine, a man or woman may not exhibit symptoms of active plumbism, yet after events frequently show that at the time lead was being passed in the urine structural changes had already been established in the kidneys and nervous system which ultimately did bring about a fatal result. I found lead in the urine of some of my patients who had left the white-lead factory 2 to 17 years previously. In two of my female patients who had retired from the white-lead factory three years before coming under my care Prof. Bedson found 1 part of lead per million in their urine, and in ascitic fluid removed from the peritoneal cavity by paracentesis abdominis, 1.5 and 2 parts of lead per million. Data such as these indicate the length of time lead can lie stored up in the body and yet become at any time a source of danger to the individual.

These remarks raise the question, When is plumbism lead poisoning? Is it only when symptoms are complained of? Analogy may help us to answer this query by "When is a disease disease?" A man hitherto regarded as healthy is following his occupation, when, without premonitory symptoms, he rapidly becomes comatose and dies within a few hours. In his urine sugar is found, and the cause of death is diabetes. No one disputes the diagnosis. Beyond its suddenly fatal termination the illness in no way differs from the more protracted type of diabetes, except in this respect: That had there been symptoms the patient could have been treated and the fatal termination probably postponed. The fact that there was no complaint, and that there were no symptoms, does not in the least alter the diagnosis. Is there not in this respect a close similarity between latent diabetes and latent plumbism? Take another illustration: There is no tuberculosis without the tubercle bacillus, but so long as the local and general resistance is greater than the influence exercised by the microorganism the patient may remain free from symptoms, unless it be an occasional cough with slight expectoration, and yet, while he himself does not complain, he, like a typhoid carrier, may be spreading the disease among other persons. If the maladies set up in other people by the microorganism given off by these bacilli hatchers are tuberculosis on the one hand and typhoid fever on the other, then surely the original carriers must be regarded as the subjects of the same diseases. Admitting this, it requires neither the utterance of a complaint on the part of an individual, the presence of symptoms, nor of active signs of a malady to be added to the existence of structural alterations of organs in order to constitute disease. In lead intoxication so long as elimination equals absorption no harmful result is perhaps noticeable. Should elimination fail storage will take place, but even then no symptoms of poisoning may be observed.

Experience shows that lead may be stored up in the tissues in an insoluble form and cause little or no inconvenience, but the individual is standing, nevertheless, on the brink of a precipice, over which he may be precipitated by a few grains of potassium iodide administered for some other illness. In my Goulstonian Lectures I mention how a maiden lady aged 72, to whom one day 7-grain doses of potassium iodide had been administered by her medical attendant for a recently developed paralysis of the eyeballs, was found dead in bed next day. At the autopsy no organic lesion of the brain was found. It subsequently transpired that the beautiful black hair of the lady, so much admired during her lifetime, was the result of the application of a lead dye. To the use of the hair dye the paralysis was probably due, just as death was the result of sudden flooding of the vascular system with lead products rendered soluble by the iodide of potassium. Another illustration may not be inappropriate, since the misadventure brought the case within the realm of the law and obtained for the relatives compensation under the workmen's compensation act. A man aged 50, previously a lead worker, but who had never exhibited symptoms of plumbism, was admitted to the Newcastle Royal Victoria Infirmary under the care of one of my colleagues, suffering from aortic disease, which was regarded as syphilitic. At the time of his admission there was no blue line on the gums. Having in view only the aortic disease and its supposed causation, the physician in charge placed the patient upon potassium iodide, with the result that within a few weeks there appeared a blue line on the gums, double wrist-drop developed, progressive emaciation was started, and cerebral symptoms showed themselves. These were the prelude to a fatal termination which quickly came. All who saw the patient were of the opinion that he was suffering from plumbism, a diagnosis which was confirmed by finding lead in the urine. This patient, who was admitted into the infirmary and treated for another disease, developed and died from lead poisoning, lit up into an active form by iodide of potassium. When did this man's illness become lead poisoning? He had months previously given up work in the white-lead factory, he had never exhibited signs of the malady, while the treatment which was adopted for another complaint led to the manifestation of plumbism and death from it. Had the lead not been stored up in the tissue of this patient, there could not have been plumbism, and had iodide of potassium not been administered, the patient might have died from the malady from which he was suffering, viz, aortic disease. The case was taken into the county court, and the relatives were awarded compensation. The difficulty in regard to latent plumbism as well as to latent microbism and quiescent disease in general is that without some external signs or symptoms we have no means of knowing of its existence. In any doubtful or suspected case of plumbism, the urine ought to be examined for lead, but, having found it, does that circumstance alone constitute lead poisoning? Perhaps not, but it would at any rate be difficult to ignore the fact and to undervalue its meaning if present in the urine on successive occasions.

Once a person has suffered from lead poisoning he becomes, as a rule, on further exposure, increasingly susceptible to other attacks. Susceptibility to plumbism is more a trait in some persons than in others. This idiosyncrasy is personal, familial, and sexual. All young adult life, but especially young womanhood, is peculiarly impressionable to the harmful influence of lead. In plumbism anaphylaxis is the rule, but now and again we come across cases where it would almost appear as if contact with lead created for a period immunity to it. These cases are few, and in no way oblige me to change the attitude I have assumed in regard to plumbism, which is that no worker, who is exposed to lead in any form, can afford to trifle with the metal, or ignore the necessity for scrupulous personal cleanliness, when working in it. The reverse of this, that is to say, personal carefulness on the part of the workpeople and attention to industrial hygiene, is productive of good. Not only are these followed by a diminution in the number of persons who become ill, but probably, too, by a reduction in the severity of the attacks. Fifteen years ago, when at the request of the home office, Sir Edward Thorpe and I were invited to inquire into, and report upon, the prevalence of lead poisoning in the manufacture of china and earthen ware, we found plumbism very prevalent in the Staffordshire potteries, and the type of the malady usually severe. A change in this respect has taken place. The district is no longer scourged as then. Dr. A. A. Hill,[1] certifying factory surgeon of Tunstall, maintains that a different type of lead poisoning is now met with in the potteries. The character and the severity of the attacks of lead poisoning have altered. He considers that the special rules have had most important results, as seen in the stamping out of the severe cases of plumbism, comprising lead encephalopathy, optic neuritis, and wrist-drop. It should be gratifying to every person interested in the pottery trade to learn that the terrible cases which gave the potteries such unenviable notoriety have considerably diminished. If the severe cases can be eliminated Dr. Hill maintains that the milder cases can, by early suspension, be kept in check.

One of the peculiarities of lead poisoning is, that its effects are not always confined to the individual contracting it. A pregnant woman who is the subject of plumbism may so poison her offspring that the child dies in utero and is stillborn, or the infant is born alive but dies shortly afterwards in convulsions. Another interesting point is, that plumbism is less frequently the result of the introduction into the system of one or of a few large doses of lead than of the repeated absorption of the metal or its compounds in small quantities over a considerable length of time.

Setting aside the skin as one of the surfaces through which lead may enter the body, the two principal channels of absorption are the alimentary canal and the respiratory passages. Of these two my own experiments suggest the alimentary canal as the more important. The large amount of lead found in the liver after death rather strengthens than weakens this statement. Notwithstanding this, it is upon the kidneys and the cerebrospinal system that lead mostly exerts its baneful influence. There is usually found in the brain and cerebellum a considerable quantity of lead.

When workmen have been exposed to lead dust, it is not always easy to say whether the metal is mostly absorbed by the alimentary canal or by the lungs. It is probably absorbed by both. When plumbiferous dust has been inhaled, the bulk of it is caught in the nares. The ciliated epithelial cells and the mucous membrane of trachea and bronchi prevent it readily reaching the lungs, but that it reaches the lungs is shown by the experiments of Laborde, who found that, in the case of guinea pigs exposed to an atmosphere in which white lead dust was suspended, the animals died within two hours afterwards, and in the lungs there was found acute congestion of the lungs, with here and there minute hemorrhages. Similar lesions were observed when the experiments of a less severe type were conducted over a longer period, such as a few days. The contention of Dr. Kenneth Goadby, who is one of the strongest adherents of the respiratory absorption of lead dust, is to some extent, therefore, supported by the facts to which Laborde lends the weight of his authority. On the other hand, the more recent experiments carried out by Saito and Prof. Lehmann at the Wurzburg Institute of Hygiene show that, notwithstanding the primary channels of entrance, during breathing, only 12 per cent of the lead reaches the lungs and that about 70 per cent is found in the alimentary canal.

There is still considerable difference of opinion as to what takes place when men and animals who have breathed the emanations given from a surface freshly painted with white lead suffer in consequence. In my book, Diseases of Occupation,[2] I draw attention to the fact that, during the preparation and mixing of paints, peculiar symptoms are occasionally complained of by the men which are not altogether due to the white lead present, but to some peculiar condition of the linseed oil. Prof. Baly, of Liverpool, on spectroscopic examination of a beam of light passed through the emanations given off by a freshly lead-painted surface, was at first disposed to regard the harmful character of these exhalations as due to lead, but further experiments convinced him that, as similar emanations are given off by linseed oil mixed with manganese dioxide, they are due to unsaturated aldehydes, arising from hydrolysis of the linseed oil. These emanations are given off more readily from surfaces painted with white lead than where zinc white has been used. They vary with the percentage of linseed oil and they are given off in descending proportion according to whether white lead, sulphate of lead, or zinc white has been the compound added to the oil. Baly is therefore disposed to regard the aldehydes evolved from freshly painted surfaces as the harmful agents and not the lead. This, however, can only be partly true. That lead emanations are also given off is more than a probability, for only thus, among other reasons, can I explain the occurrence of severe colic, anemia, a blue line on the gums, and the presence of a small quantity of lead in the urine of a previously healthy young medical man recently under my care, who became seriously ill through living and sleeping at home when all his rooms were being painted. Besides, the experiments of MM. Heim and Hébert show that lead is present in the vapor given off from painted surfaces, and that to this circumstance the plumbism of house and coach painters is due.

Attention has been drawn in some of the medical journals to the occurrence of Wassermann reaction in plumbism. I found it positive in a few of my lead-poisoned patients, both male and female, but in each instance there was not the least doubt that, in addition to lead, syphilitic infection at one time or another had also taken place and that the Wassermann reaction was related more to this circumstance than to the existence of plumbism. From what has been said in this paper of the unfavorable effects following the administration of potassium iodide, lead workers who are the subjects of syphilis run greater risks than their mates not similarly affected when both of them run the gauntlet of plumbism.

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[1] Annual Report of the Chief Inspector of Factories, 1911.

[2] Diseases of Occupation. Methuen & Co., London.

INDUSTRIAL PLUMBISM.

Francis D. Patterson, M. D., Director Department of Sanitation and Accident Prevention, Harrison Bros. & Co., Philadelphia, Pa.

The axiom that an ounce of prevention is worth more than a pound of cure is nowhere truer than in the poisoning incident to the handling of lead and its soluble compounds.

Industrial plumbism is just as much a preventable as it is an occupational disease, and this prevention can be accomplished:

First. By taking care to make the processes as dust free as possible.

Second. As it has been found difficult to enforce the use of the ordinary type of respirators, we are using with success a respirator, which I designed. These respirators are made of five thicknesses of gauze and clean ones are given to the men each day.

Third. But a slight amount of the lead dust which enters the mouth and nose passes into the lungs. Fully three-fourths of it lodges in the mouth and nose, where it becomes mixed with saliva and mucus, and is unconsciously swallowed. In order to obviate this as much as possible, it is our practice to require our employees, before taking their dinner, and when cleaning up after the day's work, to thoroughly wash out the nares with warm water, and to gargle the throat and wash the mouth thoroughly with a 0.2 per cent solution of sulphite of soda.

Fourth. Each factory should have a room, preferably in a separate building, where the employees must eat, and no food should be allowed to be carried into any other room in the factory. Care should also be taken to see that the employees properly wash before eating their dinner.

Fifth. Milk being a valuable preventative, it is provided at the company's expense, and the employees are urged to drink it freely.

Sixth. All employees are provided with clean overalls each week at the company's expense.

Seventh. Ample facilities for bathing, with soap and towels, are provided, and it is our practice to pay the men for the time which they spend in taking these baths.

Eighth. The carrying and the chewing of tobacco at work is prohibited.

Ninth. Too much stress can not be laid upon the importance of the employment of a competent physician who will make a physical examination of all applicants for employment and reexamine the employees at a weekly interval. We do not employ any men under the age of 21 years, nor those who present the physical evidences or history of alcoholism, kidney disease, syphilis, rheumatism, or any chronic digestive disturbance.

Tenth. Each employee receives a thorough physical examination each week, so as to determine those who present the evidences of being in a condition of "lead store." The recognition of this in its incipiency and the administration of the proper treatment insures the relief of the condition before it has time to progress.

Eleventh. All employees are given free medical treatment and they are encouraged to consult me for any ailment, no matter how trivial. This further insures the early recognition of any cases of poisoning.

Twelfth. In each room in the factory is a notice which tells the employees of the precautions which they should take in assisting the company in preventing lead poisoning among them.

DISCUSSION.

EDGAR T. DAVIES, Chicago, Ill.: Doubtless one of the most far-reaching and beneficial results of this present congress will be a definite improvement in the methods of gathering and compiling statistical data concerning occupational diseases. It is extremely difficult, at present, to know the exact status of this comparatively recent phase of investigation into conditions environing our industrial classes. For instance, many reputed cases of lead poisoning are, upon further diagnosis, declared not to be lead poisoning at all.

Again, I should like to lay emphasis upon statements already made that the greatest factors in eliminating these occupational diseases are not solely mechanical installations, safeguards, and so forth, but also recognized and observed shop discipline and faithful compliance with the rules of hygiene on the part of the employees.

OCCUPATIONAL DISEASES IN NEW YORK.

W. GILMAN THOMPSON, M. D., New York.

Introductory.—The city of greater New York, with its population of over 4,000,000 and numerous and varied manufacturing industries, presents fertile field for the study of industrial diseases. Only within very few years, however, has the subject received any systematic study, but at the present time active research is being prosecuted in a number of directions, so that before long the subject is certain to receive the consideration which its importance demands.

In this brief review it is impossible to cover the entire field of the occupational diseases represented in New York, and I shall select, therefore, a few of the typical industries which furnish the greater number of incapacitating disease hazards, omitting reference to the special diseases of the skin, the eye, and the nerves, which are of great interest, although less serious from the standpoint of mortality or permanent invalidism.

Lead poisoning.—The numerous trades of which lead poisoning constitutes the chief hazard—amounting to about 150—comprise a very large proportion of the sources of industrial disease in New York, as everywhere else. This is due not only to the relatively large number of workmen employed but to the virulence of the poison and the common susceptibility of almost everyone exposed to it. In the United States few women are employed in lead industries as compared with the number in some foreign countries, particularly France and England, where pottery works and other trades using lead preparations admit female workers in considerably greater number.

Sixty fatal cases of lead poisoning occurring in New York State, of which 31, or more than half, were in the city of greater New York, were recorded in the two years 1909–10. These cases have been made the subject of exhaustive report by Dr. John B. Andrews.[1] It is perhaps unfair to assume that all of these cases were due directly to lead poisoning, as some of the patients had uremia, myocarditis, and other conditions, and doubtless some were victims of syphilis, alcoholism, and other causes of disease; nevertheless, in all the plumbism was a very marked feature and hastened death.

Among the occupations recorded in this series, that of painters (house and wagon painters chiefly) predominates, as it does in most large groups of lead cases, three-fourths of the series being classed under this heading. Among the other patients of this series, 3 were employed in white-lead manufacture, 3 in smelting and refining, 2 in storage-battery manufacture, 4 in the printing trade, 1 was a tinsmith using solder, and 1 a maker of wooden toys. One victim was a woman who painted white enamel on brushes.

I have collected data of over 300 cases of lead poisoning serious enough to demand hospital or dispensary treatment, occurring in my personal service and that of my colleagues in the wards of the Presbyterian and Bellevue Hospitals, and in my dispensary clinics. About 75 per cent of these patients were painters. It is well known that the risk from inhaling the paint dust is very great in those who paint wagons, carriages, and automobiles, where the work is done indoors, and successive layers of paint are rubbed down with pumice, emery, or sandpaper to give a smooth finish. Three men who came to my clinic were victims of lead poisoning acquired from scraping with automatic air chisels the red-lead paint from the double-bottomed warships undergoing repair in the Brooklyn Navy Yard. Dr. Kenney, one of my clinical assistants, and Dr. E. E. Pratt, of the New York State Factory Investigating Commission, found about 20 cases of serious plumbism there. The men were not in the Navy, but were hired on contract, and no measures had been taken to protect them from the hazard.

Dr. J. S. Kenney, who has been keeping special records for me of all classes of plumbism in the Clinic, reports, among others, the following employments in which the patients became so severely poisoned as to require dispensary or hospital treatment: Plumbers, sheet-metal workers, carriers of lead bars, steel hardeners (using molten lead), workers in brass and a "composition metal" containing lead, white-paint enamelers, typesetters, electrotypers, paint-factory hands, and painters. Workers in all these trades were treated during six months of 1911–12. There were in all 25 cases; and as this is only one of some fity-odd dispensaries in greater New York where such patients may apply for treatment, some idea of the prevalence of lead poisoning in that city may be formed, although accurate records do not appear to have been kept elsewhere.

Brass poisoning, with "brass chills," as the workmen term their chief ailment, is common in New York. It happens that a large brass foundry is next door to my dispensary clinic, and both there and in Bellevue Hospital I have seen a number of cases. These workmen also acquire lead poisoning when the percentage of lead in the poorer quality of brass is high and suffer from arteriosclerosis and other manifestations of toxemia. One patient, who had had brass ague several times, presented also a lead line on the gums, arteriosclerosis, blood pressure of 156 millimeters, and a secondary anemia of hb. 35 per cent and red cells 2,160,000. He had been employed for eight years and handled bars of brass and copper.

Brass buffers and polishers inhale emery dust with the metallic dust. One such patient in my clinic, a young man of 23 years, had worked at this trade for several years, and had chronic bronchitis with emphysema. Another had attacks of numbness and coldness of the hands, with cramps in the legs (intermittent claudication). Endarteritis obliterans was also present. Drs. Schwartz and Sicard have reported other brass-poisoning cases from my Clinic in the medical reports of the Cornell University Medical College.

Mercury poisoning has been made the subject of an admirable study by Mrs. Lindon W. Bates, in a monograph issued in 1912 by the Woman's Welfare Department of the National Civic Federation (New York and New Jersey section). This report comprises an analysis of 102 cases occurring in New York State and vicinity, principally in the felt-hat industry in Brooklyn, Yonkers, Newark, and Orange. Only one authenticated case was immediately fatal, but in many the degree of permanent invalidism was so great as to render early death almost inevitable. Many of the cases were observed among females, a few of whom were young girls.

The large majority of cases investigated were among felt-hat makers, who use both corrosive sublimate and a solution of nitrate of mercury in the process. The industry is much subdivided, and the workers classed as "makers" are the chief sufferers, but those known as fur cutters, brushers, sizers, pouncers, hardeners, and finishers are also afflicted.

Although, as stated, the report deals chiefly with felt-hat makers, other industries are included. Three cases of mercurialism were found among makers of incandescent lights using mercurial exhaust pumps. Two cases were among chemists manufacturing mercury compounds, and two victims were makers of cosmetics.

The substitution of silver for mercury in the manufacture of mirrors has materially reduced the number of cases of mercurialism from this source. The writer can recall visiting, as a boy, a large mirror factory where the workmen poured mercury from large bowls over the plate glass, and cases of mercurialism were not rare among them, but fortunately this process has been superseded.

Phosphorus poisoning is rare in New York City, being scarcely known outside the match-manufacturing industry. Of such establishments, there are at present only 16 in the United States, and only two of these are in New York State. The intensive study of these factories, made by Dr. John B. Andrews for the United States Bureau of Labor and the American Association for Labor Legislation, and published by the National Bureau of Labor in its Bulletin No. 86, January, 1910, has finally led, in 1912, to Congressional legislation which will doubtless amost entirely eliminate phosphorus poisoning from the list of occupational diseases, so that the matter will become chiefly of historic interest. Matches made with the exceedingly poisonous white or yellow phosphorus, in order to enable them to be ignited by friction on any rough surface, are now so highly taxed as to render their manufacture economically impossible. For them will therefore be substituted the safety match, igniting only on the prepared surface of the match box, and made with the harmless red amorphous variety of phosphorus, the sesquisulphide. In the single match factory of Greater New York unhygienic conditions were found by Dr. Andrews, and no precautionary directions were furnished the workmen, but as the new law will eliminate the dangerous form of phosphorus the matter will not be further discussed here. This most creditable research of Dr. Andrews affords an admirable illustration of the value of intensive investigation of occupational disease, and the legislation secured mainly by his persistent efforts affords much hope for betterment in other hazardous trades.

Arsenic poisoning is much less common in New York since the recent substitution of anilines and other pigments for the coloring of wall papers and artificial flowers. Cases of chronic eczema, from handling various arsenical compounds, are observed in the skin clinics, however, and the few cases of chronic arsenical poisoning which enter the hospital are usually subjects of multiple neuritis. Such a case was recently seen in my clinic in Bellevue Hospital. The man was employed as a finisher of leather, which he scraped, rubbed, and polished. In part of the tanning process the leather was treated with arsenic, and as his work, at which he had been employed for 25 years, was very dusty, he inhaled sufficient arsenic to give rise to a painful multiple neuritis of both arms and legs. He was not an alcoholic subject, and had no nephritis, but a moderate arteriosclerosis. I have met with a number of similar cases of multiple arsenical neuritis acquired in different occupations. One of my patients, who had been employed for six years mixing Paris-green paint, had marked general bronzing of the skin.

Chrome poisoning or poisoning by chromic acid and chrome pigments is observed in the chemical works where these substances are prepared. Dr. C. N. B. Camac, formerly of my dispensary staff, published an article on this subject in the Medical Reports of the Cornell University Medical College. One of the cases presented the typical ulceration of the anterior part of the nasal septum, with a large perforation.

Poisoning by the fumes of mineral and other acids used in cleaning and other processes may produce serious effects, such as bronchitis, extreme anemia, digestive disorders, etc. A patient in Bellevue Hospital had been employed for four years in a large milk laboratory where he used acids in making butter-fat tests and in cleaning copper vessels. He suffered from dyspnea, weakness, a decided nephritis, and an anemia which showed 40 per cent of hemoglobin and 3,800,000 red blood corpuscles. Another of my patients, a lad of 14 years, had been employed for two months cleaning glass with acid in an art-glass factory. He complained of nausea, vomiting, diarrhea, and vertigo. He had before been in good health, and always felt better on Sundays, when he did not work. He stated that many of his coworkers had similar symptoms, but he did not know the nature of the acid given him to use.

Wood alcohol, or methyl alcohol, is a cheap solvent for shellac and similar substances. Being extremely volatile, it becomes exceedingly dangerous when applied in thin layers over large surfaces and in a confined space. It is strongly and rapidly hemolytic, and is a virulent depressant and cardiac poison, producing death in coma in a very short time when inhaled in concentrated form. In victims who recover from inhalation of its fumes permanent blindness from optic neuritis and other eye lesions may result. From a brewery in Buffalo one case of death and one of permanent blindness were recently reported to the New York State Labor Bureau and in a brewery in New York City there have been three deaths from this cause within the past few years. So little is known by many physicians of this virulent poison that one of the deaths was reported to the health department as due to epilepsy! The shellac is used in the interior of large beer vats having a small vent at the bottom and a small manhole at the top, with no other opening.

Men go inside, work for 20 minutes, and then come out to breathe before reentering. To hasten their work they use broad whitewash brushes, which, of course, spread the shellac quickly over large surfaces. No attempt is made to force fresh air into the vats. This is one of the industries which, owing to exceptional hazard, should be controlled by legislation, and for use in such confined atmosphere the substitution of grain alcohol as a solvent should be required.

Silica.—An occupational hazard, due to dust of unusual origin, came recently to my notice. A friend who was being shown through a large soap manufactory in New York began to cough and sneeze violently. He also noticed that the girls employed all had their hair done up in paper bags. On inquiry it was found that to make a scouring soap a fine earth containing microscopic spicula from fossil animalculæ was added. In time the employees become used to the bronchial irritation, but the scalp, unless protected, presents intolerable itching and may become ulcerated.

Street cleaners and ash men.—It might be supposed that this class of workmen would be especially liable to dust inhalation with resulting chronic bronchitis, pneumonokoniosis, or tuberculosis. Such, however, is not the case, and probably the open air of such labor proportionately raises the coefficient of immunity. Drs. John Rogers and Bleiman a few years ago made a thorough examination of the entire street-cleaning force of New York City, with the result that they found no more tuberculosis or chronic bronchitis among the workers than would be present in any large group of laborers. An examination made again in 1911 showed only 67 cases of tuberculosis among the 7,220 employees of the department in Manhattan, or 0.9 per cent. Moreover, it is probable that many of the tuberculous men had the disease in latent form when they entered the force.

Wood sawyers and pattern makers are employed in great numbers in New York. Most of the large planing mills are now well ventilated with fans and in these classes of workmen there is no marked frequency of occupational disease. A friend who employs many workmen in sawing rare woods for veneering, and also much boxwood, asserted that the only hazard he ever knew among them was the following amusing incident: A new East Indian wood, on being sawed into thin slabs, filled the workroom with fine red dust. At the luncheon hour one of the workmen dipped his head into a bucket of water to wash out the dust, when his hair promptly turned a bright green color, due to some unknown dyestuff in the wood.

The sandblasting of wood as a finishing process is a hazardous but not very common trade.

Furriers, hair pickers, and upholsterers are employed in large numbers in New York City, but anthrax is almost unknown among them. Since the passage of the law, in September, 1911, requiring the notification to the New York State Labor Bureau of cases of this disease only two or three have been reported from various parts of the State.

The menace from dust in these occupations, however, is very great, and the employees usually suffer in time from chronic bronchitis with fetid expectoration. One of my patients, who began as an upholsterer's assistant at 13 years of age and later worked as a hair picker, had a chronic cough for 20 years and finally developed tuberculosis. Another, for 10 years a cutter and cleaner of furs, presented a bronchiectatic cavity. At a fur-manufacturing establishment in the interior of the state pulmonary abscess is very common among the employees. The hair dust inhaled carries a variety of germs with it into the lungs.

Compressed-air illness.—Ever since the first comprehensive study of this topic in this country was made by my colleague in the Presbyterian Hospital, the late Dr. Andrew H. Smith, physician to the caisson workers of the Brooklyn Bridge in 1872–73, caisson and under-river tunnel boring has been increasing. With five completed double tunnels under the East and North Rivers and a great number of "skyscrapers" with very deep foundations, the field for study of compressed-air illness has been unsurpassed anywhere else in the world. In addition many bridges over the Harlem River have required caisson construction, as does the new aqueduct which passes under both the Hudson and Harlem Rivers. The most extensive personal experience with the compressed-air illness of tunnel workers, as yet reported, was described by my clinical assistant, Dr. Frederick L. Keays, for the Medical Report of the Cornell University Medical College in 1909. As physician to the Pennsylvania Railroad he studied 3,692 casses of compressed-air illness with 20 deaths among the 10,000 workmen employed in the construction of four of the great river tubes built by this railroad, practically all of which cases were due to too-hurried exit from atmospheres of from 30 to 40 pounds of air pressure above the normal. As the tunnels are very long, an interesting opportunity was afforded of studying the men under varying conditions of ventilation, while walking in the tubes, as well as while working. In most cases, owing to the distances to be traversed, decompression was made continuous, excepting with two interruptions of about 10 minutes each, the total time for decompression from 40 pounds being 48 minutes, instead of by Haldane's method of sudden partial decompression to 12½ pounds, followed by very slow decompression, which would have required 90½ minutes.

Garment makers.—One of the largest industries of New York City is that of garment workers—i. e., wholesale tailoring, cloak making, shirt-waist making, and so forth. A large proportion of these employees are Hebrews who are prone to neuroses of various kinds, and in these employments many acquire tuberculosis as well. They have long hours of work, often in dusty, ill-ventilated, overcrowded rooms. They frequently use gas stoves or charcoal ovens for heating flatirons, and often work under the pressure of "speeding up," to finish tasks under contract, and to comport with changes in the seasons. They also often work in strained positions over machines which require operation by hand or foot. Investigations conducted by Dr. Graham Rogers, of the New York State Labor Bureau, have shown that the dust accumulation from cotton and wool fibers in these industries is as high as that in the pearl-button industry.

If a patient enters my Clinic with a cough and says he is a "presser" or "machine operator," he is almost certain to have pulmonary tuberculosis with chronic bronchitis. The leaky gas stoves and gas flat-irons contribute chronic illuminating gas poisoning, with symptoms of marked anemia, headache, and digestive disorders. In the New York City Health Department tuberculosis clinic, nearly 2 per cent of all the patients are garment workers.

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[1] Bull. 95, United States Bureau of Labor, 1912.

LEGAL PROTECTION FOR WORKERS IN DANGEROUS TRADES IN THE UNITED STATES.

JOHN B. ANDREWS, Secretary American Association for Labor Legislation, New York City.

The need of legal regulations for the protection of workers in dangerous trades requires argument no longer. The need is apparent to anyone familiar with the facts.

It is admitted that the worker is entitled to a reasonably safe place in which to labor. This was acknowledged long before any considerable number of people agreed that legal regulation of working hours and wages was justifiable. Moreover, the reasonableness of sanitary regulations as a legitimate interference with work conditions prescribed by the employer and suffered by the employee has been more uniformly upheld by the courts than any other kind of labor legislation.

And, although it is also understood that in every industry there are employers who furnish model establishments, it is nevertheless perfectly clear to anyone who knows the facts that these more progressive and humane employers, as well as the employees of their less scrupulous competitors, need the protection of compulsory uniform standards of safety which can be secured only through legal enactment.

Most of our labor laws in America are for the promotion of the health and safety of the workers. Laws limiting the working hours of women, for example, have notoriously found their chief defense in the arguments of the medical profession. In the interest of health, too, a few American States have already prescribed a maximum 8-hour day for adult men in mines and smelters. The Federal Government has recently, by the extension of the 8-hour day to all subcontract work for the United States Navy, taken a step which is likely to have far-reaching results. These laws, as well as workmen's compensation or insurance for industrial accidents, are extremely important in their effect upon the safety and health of the workers.

But important as these more general regulations are they must be regarded in this discussion as subordinate to the special regulations for the prevention of accidents and diseases. These labor laws for the particular regulation of the hazard of employment in the United States may be briefly summarized as follows:

I. REPORTING OF INDUSTRIAL INJURIES.

(1) *Accidents.*—Forty-two States have now enacted laws providing for the reporting of industrial accidents either in factories, in mines, or on railroads.

(2) *Diseases.*—During 1911 and 1912, for the first time in America, eight States (California, Connecticut, Illinois, Maryland, Michigan, New Jersey, New York, and Wisconsin) enacted laws requiring physicians to report all cases of certain diseases of occupation, including anthrax, compressed air illness, and poisoning from lead, phosphorus, arsenic, and mercury, or their compounds.

II. PREVENTION OF INDUSTRIAL INJURIES.

(1) *Accidents.*—Forty-eight States have laws of various kinds designed to provide for the installation of safety devices and to protect workmen against industrial accidents.

(2) *Diseases.*—General legal regulations in the interest of comfort and health have been adopted as follows: Provisions for protection against (*a*) injurious dusts, in 22 States; (*b*) improper lighting, in 12 States; (*c*) poisonous gases, fumes, and vapors, in 15 States; (*d*) excessive temperature and humidity, in 11 States; (*e*) work in compressed air, in 1 State (New York).

By an act of Congress (Apr. 9, 1912) the manufacture of poisonous phosphorus matches is prohibited in the United States after July 1, 1913.

III. INSURANCE AGAINST INDUSTRIAL INJURIES.

(1) *Accidents.*—Fifteen States have workmen's compensation or accident insurance laws, all of which were enacted during the last two years.

(2) *Diseases.*—In the recent development of workmen's compensation and insurance legislation, no provision has yet been made in the United States for insurance against occupational diseases.

The industrial accident problem has been studied for years and it is more discussed now than any other question in the field of labor legislation. It is only within the last few years, however, that our industrial disease problem has received specific attention. Consideration of this latter question alone, therefore, will perhaps be more profitable and should serve to indicate how serious is the task of providing safeguards against the hazards of industrial employment.

In general, certain trades are unhealthful and require regulation, principally because the workrooms under ordinary conditions are likely to be poorly ventilated. More specifically the harmful conditions of employment are frequently due to the presence of dusts, gases, vapors, and fumes; to extremes of temperature, humidity or density of the atmosphere; and to improper lighting and overstrain.

The evil results of unhealthful conditions have long been recognized, and in every industry there are humane and intelligent employers who devote much time and money to the elimination of unnecessary hazards. Whether prompted by humanitarian or commercial considerations, these advanced employers frequently provide model establishments. By their commendable efforts they also help to establish reasonable standards of comfort and safety which, when drafted into labor law, constitute uniform minimum requirements for all employers in the same industry. But only through the uniformity of regulation which legal enactments alone can secure, can these more progressive and humane employers be themselves protected from less scrupulous competitors who would otherwise often fail to go to the expense of providing adequate safeguards, and only through such compulsory uniformity can the health of the employees of these competitors be protected.

It frequently happens, moreover, that even a vast majority of the manufacturers in a given industry claim that they are unable to bring about reforms, which they freely admit are desirable, without the aid of uniform legal regulations to force the recalcitrant minority into line. A striking example of this, the condition which culminated successfully in the poisonous phosphorous match prohibition act, is still fresh in the public mind. Match manufacturers, representing 95 per cent of the total product, testified before Congress that they could not substitute a harmless compound for the slightly cheaper poisons without a uniform law compelling all manufacturers in that industry simultaneously to abandon the poison. Match manufacturers representing the remaining 5 per cent of the product stood out stoutly until the last, declaring that they would close their factories before they would submit to this sanitary regulation already in compulsory operation in practically all the civilized countries of the world. It required labor legislation to prohibit the use of this unnecessary deadly poison before "phossy jaw," the most loathsome of all industrial diseases, could be abolished.

For other industrial poisons there are harmless but more expensive substitutes. Automatic mechanical processes can be substituted for dangerous methods still conducted by hand labor. Scores of operations in the present list of particularly insanitary trades can be made safe by the use of scientific apparatus for the removal of dangerous dusts and fumes.

The unhealthful trades demanding legal regulation may be conveniently classified according to the nature of the principal hazards:

(1) Trades menaced by specific industrial dusts, fumes, gases, vapors, and acids (poisonous and nonpoisonous).

(2) Trades menaced by compressed or rarified atmospheres.

(3) Trades menaced by improper light.

(4) Trades menaced by excessive temperature and humidity.

(5) Trades menaced by excessive strain.

Hundreds of peculiar injuries caused by these unhealthful conditions of employment are now beginning to receive serious attention in America as special diseases of occupation. This new line of study is most encouraging to those interested in securing effective legal regulation of unhealthful trades, because it has long been recognized by the people most familiar with the facts that specific studies, leading to the establishment of more definite standards of safety, are necessary before much even of the now existing legislation can be effectively enforced.

While such researches are under way we should emphasize at every opportunity the following considerations: (1) All preventable occupational diseases must be prevented; (2) those occupational diseases which we do not yet know how to prevent must be reduced to a minimum; and (3) the victims of occupational disease must be compensated for their injuries by some just system of insurance.

Efforts to carry out this program lead naturally to three principal methods:

(1) *Absolute prohibition.*—Through the successful outcome of the efforts to secure a prohibitory tax upon matches made with poisonous phosphorus, an avenue of tremendous possibilities, if carefully followed and not abused, is opened up for the further conservation of human life.

(2) *Regulation.*—There may be specific or general regulations:

(A) Specific regulation: For the sake of clearness we may recall, as an illustration of specific regulation, the earlier history of the match industry, when several countries, before harmless substitutes for poisonous phosphorus were discovered, attempted to prevent "phossy jaw" by requiring, (*a*) that match paste should contain not more than 7 per cent of the deadly poison; (*b*) that no one should be permitted to work in the poisoned atmosphere of a match factory more than eight hours in any one day; and (*c*) that children should not be so exposed. There were, then, in this intermediary period of specific regulation three definite limitations, (1) upon the hazardous material, (2) upon the period of exposure, and (3) upon the persons exposed. By this method of specific regulation also there are extensive possibilities for legal regulation in the interest of human health.

(B) General regulation: This method is, unfortunately, the most common. If, again, for the sake of clearness, we make final use of the match-factory illustration, we recall that before prohibition was thought of and before specific regulation had been tested, most countries had made vague efforts, through general regulations, to provide education, ventilation, and cleanliness for the promotion of the comfort and health of workers in match factories. This general method lends itself most readily to that large group of trades in which the occupational causes of industrial maladies are least clearly defined.

It marks the earliest stage of regulation where, on account of complex conditions of employment, we are still feeling our way in partial darkness without definite standards for our guidance.

(3) *Insurance.*—It is now recognized that the campaign for workmen's compensation or insurance for industrial accidents, both in Europe and in America, has been the greatest practical force in the prevention of such injuries. No intelligent person can go far in the study of insurance against industrial accidents without realizing that a logical consideration of the facts must lead likewise to insurance against industrial diseases. A workman, incapacitated by disease contracted in his trade and due to his employment, is as much entitled to compensation as if he had been disabled by an accident. In many European countries this principle is already established.

In all attempts to control dangerous trades the method of general regulation has naturally preceded specific regulation and absolute prohibition as well as insurance. On paper it is by far the easiest and unfortunately creates a temporary impression of accomplishment which is quite fascinating to the occasional-day reformer. It is probably a necessary first step in most industries where definite, enforceable, scientific standards must wait upon investigation and practical experiment.

In attempting to deal intelligently with these problems, our bill drafters are hopelessly baffled by the lack of scientific standards. And nothing is more clear to serious students of the subject than the unavoidable conclusion that effective laws for the regulation of unhealthful trades can not be properly drafted by busy and harassed legislators in the midst of legislative sessions. In the field of industrial hygiene no greater contribution could be made at the present time than the establishment by a commission of experts of such standards.

The existing laws in this country for the regulation of factory labor in the interest of the comfort and health of the workers are for the most part formulated on general lines—confused, indefinite, and full of loopholes. In the 15 States which even pretend to protect workers from the effects of poisonous gases, fumes, and vapors the laws seldom give more definite directions than that such dangerous gases, fumes, and vapors must be removed or rendered harmless "when injurious to the health of employees," or "so far as practicable," or "if necessary." In one State the law sweepingly provides for all health protection by stating that the factory inspector "shall also examine into the sanitary conditions of factories, workshops, mines, and quarries, and when any condition or thing is found that, in his opinion, endangers the health or lives of the employees, he shall notify and direct the employer to rectify the same." This class of statute law, which is quite common, places no duty upon the employer to provide proper protection until he is ordered to do so by the inspector. When one considers the area to be covered in our large industrial States and the number of work places to be inspected, it can easily be seen that workers depending for their safety upon the specific orders of a limited number of inspectors are likely to receive entirely insufficient protection from laws of this character.

Although work in compressed air has become an important element in the building trades of this country, New York is still the only State which has a scientific law relating to work of this character.

There are only 12 States that make any mention of the subject of light in their general factory or labor laws. And " in not one of these," says a well-known efficiency engineer, " are the provisions sufficiently specific to render them of practical value."

Laws intended to protect the workers from injurious dusts in factories have been enacted in 20 States, but they are generally very crude and, in practice, more or less ineffective. " Drastic legal requirements alone," says the leading American authority on this subject, " are certain to bring about the required degree of comfort and health."

One reason that many safe methods are not in operation at the present time is simply that many employers, busy with the making of profits, have had no sufficient incentive to turn their attention to factory sanitation; and another reason is that State factory inspectors have not always been fully aware of their opportunities and responsibilities. The motive which leads some intelligent employers properly to equip their plants with safeguards is undoubtedly the conviction that it increases the efficiency of their workmen. There is abundant testimony to that effect from the rapidly rising profession of efficiency engineers and from their patrons. But even the most enthusiastic " boosters for safety " among the thoughtful efficiency experts recognize the absolute necessity for the establishment of uniform legal standards of safety, if the health of the great majority of factory workers is to be conserved.

Recently a few of the less thoughtful enthusiasts in the popular agitation for efficiency have failed to get the true perspective and have clamored for protection for the workers solely upon the ground that " it pays " the employer. Let us congratulate ourselves that those who are in danger of losing their health and their lives in their daily toil have in some instances at least that incidental advantage. But let us have less of this everlasting dinning in our ears, that before we ask for decent protection for the workers we must first demonstrate that each advance toward health and safety will actually put additional dollars in the pockets of employers. Let no one forget, meanwhile, that the philosophy of mercenary profit, when carried to its logical conclusion, in some instances may result in less than decent protection when it is not clear that profits will respond immediately to the expense of safety. No man in this Republic shall be permitted for a moment to forget that, no matter how urgent is the duty to protect the property of citizens, society has a much higher responsibility, the protection of human life.

In our efforts to secure the necessary information upon which to base intelligent legislation we must draw more and more upon the expert service of the physician. Eight States have already enacted laws requiring medical reports on the most easily recognizable diseases of occupation. These reports will indicate special danger points for intensive duty within industrial establishments. All cases of occupational disease should be reported. They should be reported much more carefully and completely than accidents are now reported. And these records should not be regarded as mere statistical information for annual reports. They should be followed up in the industrial establishments by a State factory inspector properly qualified to do that kind of work. This will emphasize the growing need for medical inspection of factories. Periodical physical examination of workers in particularly hazardous trades is now required in one State, and the regular medical inspection of factories. now unhappily limited to three States, will undoubtedly be rapidly extended within the near future. This will lead likewise to the consideration of the industrial origin of many diseases and will elicit the interest of medical men who can, if they will, be of great social service in helping to solve the occupational-disease problem in the only proper way—that is, by prevention. One of the most valuable aids in this work should be the establishment of one or more medical clinics for the study of such maladies. Perhaps America could not do better than to follow the model of the first institution of this kind. at Milan. Italy. At our international congress in Switzerland, September. 1912. for three days leading authorities sat around tables and discussed this occupational-disease question. One of the most inspiring things at that meeting was the presence of medical men and factory inspectors from the "labor clinic" at Milan. They were there with a wealth of scientific data based on careful experiments and investigation. They had the advantage of more than two years' special experience in an institution provided with laboratories. clinics, and hospital wards. and dedicated to the solution of this perplexing and complicated problem. There can be no good reason why a similar institution should not be established in America. We need experts as badly as any other country.

In one respect at least we have already taken the experience of the most progressive European countries and have even improved upon it. It is pleasing to note also that this progressive step is in the field of law enforcement. The administration of the labor law has been one of our greatest problems. The Wisconsin Industrial Commission, organized last year, is clothed with extraordinary powers, including the issuing of special orders having the force of law. Its work is being watched with the greatest interest, and its success will offer new encouragement to workers in this field.

We have made a beginning, then, in developing legal regulations for the prevention of industrial diseases. The filling in of the bare outline already provided will require years of effort, while the ultimate insurance of workers against sickness due to industrial employments is a big problem still scarcely discussed among us. Medical colleges might well include regular courses on industrial hygiene; hospitals, too, will be expected to improve their system of records; and, in the leading industrial centers, we shall eventually have special clinics and wards for the study and prevention of industrial diseases. Recent developments indicate that the medical profession will not evade its opportunity and responsibility.

For many years it has been our shame that in this field we have lagged far behind some of the countries of Europe. Our scandalous disregard for the safety and health of workers is widely known. But, in this country, true reform waits not so much upon sentiment as upon facts. We are just beginning to utilize the materials at hand, and our machinery for scientific cooperation in promoting industrial hygiene is but fairly set in motion. We move rapidly when once under way. Let us press on, in the hope that another generation may see America leading the nations of the world.

THURSDAY MORNING, SEPTEMBER 26, 1912.

OCCUPATIONAL DISEASES AND THE PHYSICAL EXAMINATION OF WORKERS.

Dr. George M. Price, Director of Investigation, New York State Factory Investigating Commission, New York City.

Occupational diseases may be broadly divided into two classes. In the first division belong all those diseases in which the etiological relation of the occupation is direct, easily traceable, and fairly constant. All the industrial intoxications and the various pneumonokonioses may be included in this class; likewise those injuries and accidents due to gases and fumes and those diseases caused by the infectious bacteria of materials. In the second class of occupational diseases belong those diseases which have but an indirect relation to the occupation. These diseases are more difficult to trace than those of the first class, being less persistent and certain. In this group may be included the many ills which workers are heir to—ills which owe their origin to occupation or some elements of occupation, but so indirectly that their incidence to the occupation appears altogether remote. By far the majority of all of the occupational diseases belong to the second class.

The study of the etiological relations of the diseases in the first group is comparatively simple. The morbific elements of certain occupations are fairly well known and determined and may be in most cases experimentally produced. Hence the study of infections and industrial poisons has rapidly progressed within the last decade.

The study of the etiology of the diseases in the second group, however, is very difficult, because the effect of the industry upon the health of the worker in these occupations is hard to trace. In the study of these diseases it is not sufficient to know the various elements and conditions of the occupation, but it is also necessary to reckon with comparative mortality and morbidity rates of workers in the different occupations.

Mortality statistics are unfortunately not very satisfactory or conclusive. Some of the reasons for this are (1) the comparatively small registration areas; (2) the lack of uniformity in the form of the certificates; (3) the absence of data as to duration of employment; (4) the inaccurate statement of occupations; and (5) the defective nomenclature of occupations.

The best standard of the healthfulness or dangers of an industry would be a direct study of the physical condition of its employees, and especially of those who have worked in it sufficiently long to be affected by it.

There are but two sources for such morbidity statistics—the records of sick-benefit associations and direct medical examinations of large numbers of employees in various trades.

Unfortunately, the records of European sick-benefit societies are not of very much value in the study of American conditions, and here in the United States data gathered in like manner are conspicuously absent. Nor is a study of occupational diseases possible from data obtained by medical examinations of workers, as such examinations have been almost entirely neglected.

So far as I know, Dr. James Alexander Miller's examination of 200 printers, as reported by him in the International Congress on Tuberculosis in 1908, was the first and only examinations of workers made in this country before my own recent examinations.

In my capacity as director of investigation for the New York State Factory Investigating Commission, I conducted, in the latter months of 1911, a medical examination of 800 bakers and 83 furriers. In the summer of this year another examination was made of 600 tobacco workers. In addition to these examinations, it was my privilege, as chairman of the executive committee of the joint board of sanitary control in the cloak and suit industry, to conduct a medical examination of 800 cloakmakers in the winter of 1912.

The examinations were made by competent physicians with hospital experience; the women tobacco workers were examined by Dr. Fannie Dembo, a very competent woman physician. The cloak shops and all the tobacco factories assigned separate places to the physicians for the examinations. The bakers were examined in the cellars where they worked. The furriers were examined at the headquarters of their union.

In most cases where tuberculosis of the lungs was diagnosed by one physician a confirmatory examination was made by a second physician. Sputum examinations were made in the first 120 cases, but proved negative and were of no value, as it was impossible to get sufficient sputum at the time. A urinalysis was made only in special cases. No blood examinations were made. Anemias were diagnosed by conjunctival and facial paleness.

NOTES.—Of the 2,283 workers examined, 72.5 per cent of the tobacco workers, 98.2 per cent of the furriers, 98.8 per cent of the bakers, and 100 per cent of the tailors were foreign born.

All the bakers and furriers examined were males. All the tobacco workers and 30 per cent of the cloakmakers were females.

Most of the workers were between 16 and 44 years of age. The following percentage were above that age: 14.1 per cent of the bakers, 12.2 per cent of the cloakmakers, and 8.7 per cent of the tobacco workers.

A large number of those examined—i. e., 90.4 per cent of the bakers, 67.2 per cent of the cloakmakers, 52.8 per cent of the tobacco workers, and 48.2 per cent of the furriers—had been employed in their trade for 5 years or more.

Only a small percentage had worked at their trade for less than one year—none of the furriers, 1.2 per cent of the tailors, 3 per cent of the bakers, and 13.2 per cent of the tobacco workers.

The results of the physical examination of the bakers have been published in the preliminary report of the New York State Factory Investigating Commission for 1912; the detailed tables for the examination of the other workers will be published in the report of 1913.

PERCENTAGE OF MORBIDITY.

The general morbidity rate of the workers examined was as follows: Furriers, 89.2 per cent; tobacco workers, 71.3 per cent; tailors, 62.7 per cent; bakers, 57 per cent.

It will be seen that these morbidity rates do not differ very much from the 69 per cent morbidity rate of printers, as reported by Dr. J. A. Miller. It is also interesting to compare this morbidity rate with the rate in the Workingmen's Circle, which is an organization consisting of over 30,000 members, of the same class of workers as those examined by us. Their rates for the last five years are:

Year.	Number insured.	Cases of sickness.	
		Total.	Per 100 insured.
1907	10,757	1,287	12.0
1908	15,417	2,166	14.0
1909	26,582	3,665	13.8
1910	33,143	5,955	17.9
1911	32,449	6,237	19.2

Of course the fact has to be taken into consideration that the morbidity rates of the Workingmen's Circle, a society which gives sick benefits, must necessarily be less than the morbidity rate found in a general physical examination of workers in their shops who are able to pursue their work. In the following table I have given the general results of our examination without going into the details of age, duration of employment in the trade, nationality, and so forth. I have also included Dr. Miller's table of examination of printers.

	Bakers.		Tailors.		Tobacco workers.		Furriers.		Printers.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Number diseases	347	43.0	298	37.2	172	28.7	9	10.8	63	31.0
Number with one or more diseases	453	57.0	502	62.7	428	71.3	74	89.2	140	69.0
Total number examined	800	100.0	800	100.0	600	100.0	83	100.0	203	100.0
General:										
Phthisis	19	2.4	13	1.6	8	1.3	5	6.0	34	16.7
Rheumatism	47	5.9	45	5.6	30	5.0	6	7.2	......	......
Anaemia	183	22.9	173	21.7	74	12.3	......	......	2	1.0
Venereal	3	.4	2	.2	......	......	......	......	......	......
Total	252	31.6	233	29.1	112	18.6	11	13.2	36	17.7
Nerves and special senses:										
Ear	......	......	7	.9	7	1.2	......	......	......	......
Eye	92	11.5	51	6.4	72	12.0	8	9.6	6	2.9
Nose	6	.8	35	4.4	70	11.7	42	50.6	20	9.9
Nerves	6	.8	18	2.2	22	3.7	1	1.2	2	1.0
Total	104	13.1	111	13.9	171	28.6	51	61.4	28	13.8
Circulatory:										
Heart	54	6.8	36	4.5	25	4.2	5	6.0	6	2.9
Arteries	......	......	32	4.0	......	......	......	......	......	......
Varicose veins	41	5.1	1	.1	2	.3	......	......	......	......
Total	95	11.9	69	8.6	27	4.5	5	6.0	6	2.9
Respiratory:										
Bronchitis, acute	......	......	25	3.1	6	1.0	......	......	......	......
Bronchitis, chronic	177	22.1	56	7.0	15	2.5	25	30.1	11	5.4
Larynx	......	......	7	.9	12	2.0	......	......	1	.5
Pleurisy	2	.3	6	.7	1	.2	......	......	33	16.3
Asthma and emphyzema	21	2.6	16	2.0	......	......	11	13.3	8	3.9
Total	200	25.0	110	13.7	34	5.7	36	43.4	53	26.1
Pharynx	14	1.8	......	......	153	25.5	13	15.7	34	11.8
Tonsilitis	21	2.6	106	13.2	4	.7	3	3.6	......	......
Total	35	4.4	106	13.2	157	26.2	16	19.3	34	11.8
Digestive:										
Digestive organs	15	1.9	45	5.7	104	17.3	3	3.6	2	1.0
Hernia	26	3.2	17	2.1	......	......	......	......	4	2.0
Total	41	5.1	62	7.8	104	17.3	3	3.6	6	3.0
Genito-urinary:										
Nephritis	2	.3	3	.4	......	......	......	......	......	......
Pelvic	......	......	79	9.9	142	23.7	......	......	......	......
Total	2	.3	82	10.3	142	23.7	......	......	......	......
Skin:										
Contagious	......	......	1	.1	1	.1	2	2.4	......	......
Noncontagious	......	......	10	1.3	4	.7	19	22.9	4	2.0
Total	59	7.4	11	1.4	5	.8	21	25.3	4	2.0
Locomotion:										
Bones	......	......	1	.1	2	.3	......	......	......	......
Joints	[1] 54	6.8	28	3.5	50	8.4	......	......	1	.5
Total	......	......	29	3.6	52	8.7	......	......	1	.5
Total number of cases	842	......	813	......	804	......	143	......	168	......

[1] Flat foot.

The salient points to be gathered from the table are as follows:

(1) The tuberculosis rate found among the various workers differs considerably. In our examination the highest rate, 6 per cent, is shown among the furriers, although the number of men examined

is rather too small to be conclusive. Among the three other classes of workers the bakers stand highest, with a percentage of 2.4; cloakmakers next, with a percentage of 1.6; and tobacco workers, with a percentage of 1.3.

It is of interest to compare these rates with the 17 per cent of tuberculosis found by Dr. Miller among the printers. On the other hand, the tuberculosis rate adduced in Table I is much higher than that prevailing in the Workingmen's Circle, where the rates for the last five years are as follows:

Year.	Number insured.	Tuberculosis.	
		Total.	Per 100 insured.
1907	10,757	26	0.24
1908	15,417	60	.39
1909	26,582	139	.52
1910	33,143	190	.57
1911	32,449	213	.66

(2) As to diseases of nerves and special senses, the furriers stand highest, with 50.6 per cent suffering from diseases of the nose. We also found a comparatively large number of eye diseases—12 per cent among tobacco workers, 11.5 per cent among bakers, 9.6 per cent among furriers, and 6.4 per cent among tailors.

(3) The rates of workers suffering from cardiac troubles do not differ very much. They are as follows: 6.8 per cent among bakers, 6 per cent among furriers, 4.5 per cent among cloak makers, 4.2 per cent among tobacco workers, and 3 per cent among printers. Of the bakers, 5.1 per cent suffer from varicose veins, whereas tailors and tobacco workers, whose work is sedentary, suffer comparatively little from varicosities.

(4) A very large number of furriers, 30.1 per cent, suffer from bronchitis, acute and chronic; 22.1 per cent of the bakers; 10.1 per cent of tailors; and 3.5 per cent of tobacco workers. These rates are considerably higher than the rate of 5.4 per cent of printers suffering from bronchitis, as quoted by Dr. Miller.

As is to be expected, a large number of tobacco workers, 25.5 per cent, suffer from diseases of the pharynx; also a large number, 15.7 per cent, of furriers.

The nature of this paper does not permit further deductions from these statistics, but I may add that I can not overemphasize the importance of medical examinations of industrial workers if comparative morbidity rates are to be established.

Our ideal should be a compulsory preliminary examination of all workers entering each trade, supplemented by periodical examination during their employment in the trade. Only by such authoritative examinations will it be possible to determine the effects of an industry upon the health of the workers in it and to determine effective measures for the prevention of occupational disease.

DISCUSSION.

Miss Margaret McMillan. The question was raised as to whether the beginning of the working life is not a late stage at which to make an examination for tuberculosis. It is easy and practicable, not only to make this examination, but to provide treatment at a comparatively low cost, by means of health centers (including open-air schools and night camps, without removing the children far from their homes) as a part of the work of school medical inspection. At the Deptford (London, England) health center children selected as anemic and on the verge of contracting disease, and also a few cases already attacked, were cleared up entirely after six months' sleep in the open. The cost of fitting up the night camp for 20 children was $100. The camp is close to the homes of the children and is visited daily by many of the parents. It is under the supervision of the school medical officers of the center.

Dr. Ernest D. Easton, Newark, N. J. What per cent of employees are suffering from anemic conditions, and therefore susceptible to tuberculosis and other diseases, as shown by hemoglobin or other tests?

Dr. G. M. Price. No hemoglobin tests were made. Conjunctival and facial evidence showed the following: Bakers, 183 (22.9 per cent); tailors, 173 (21.7 per cent); tobacco workers, 74 (12.3 per cent).

EXAMINATION OF EMPLOYEES FOR TUBERCULOSIS.

Theodore B. Sachs, M. D., Chicago, Ill.

Systematic examination of employees for tuberculosis leads to the detection of the following classes of cases:

I. "*Open*" *tuberculosis* (tubercle bacilli in the sputum). Most of these cases are moderately or far advanced; a small proportion are just beyond the incipient stages.

II. *Active tuberculosis, still "closed"* (no tubercle bacilli in the sputum), a class of cases varying according to activity and extent of the process; chiefly incipient, some advanced. Unless given timely and efficient treatment, a large percentage of these cases pass into Class I (become "open," communicable).

III. *Inactive tuberculosis;* signs of a healed lesion; no symptoms of active disease. A previous history of active tuberculosis or a tuberculous family history can be elicited in a large proportion of these cases.

IV. *Predisposition to tuberculosis* (by malnutrition, anemia, or any debilitating condition).

METHODS OF SOLUTION APPLICABLE TO EACH CLASS OF CASES.

It will be seen from the consideration of the above-stated classes of cases that the tuberculosis problem in a working place presents the following important phases for solution:

1. *Detection and segregation of "open" cases of tuberculosis.*—A large number of these cases in working places without medical supervision remain undetected for months or years, acting as prolific sources of infection. Their elimination from close association with other employees, as well as the immediate institution of hospital, sanatorium, or, if feasible, home treatment, is an imperative step in the interest of those afflicted as well as of the entire working force. Institutional treatment best safeguards the interests of all concerned.

Those with the tuberculous process arrested and working power restored by institutional or home treatment, but still showing tubercle bacilli in the sputum, may be given either suitable outdoor work or indoor work in hygienic, well-ventilated quarters, but not in close contact with other employees. Conscientious, painstaking use of all the necessary precautions on the part of the tuberculous employee is a factor to be considered in the solution of each individual case.

The number of "open" cases of tuberculosis discovered during the first few months of operation of an efficient system of medical examinations may be considerably larger than at any subsequent time, and yet the number of "open" cases is small as compared with the entire working force or the second, third, and fourth classes of cases above mentioned.

It is not the number of "open" cases but the possibility of transmission lurking in each case of this group through indiscriminate expectoration that renders control of "open" cases of tuberculosis most important from the standpoint of health of the entire working force. An efficient system of medical examinations in a working place should have, as one of its most important objects, the timely detection and control of these cases.

2. *Sanatorium or home treatment of "closed" active cases of tuberculosis.*—As previously stated, cases of "closed" active tuberculosis vary considerably, according to the degree of activity and the extent of the tuberculous process. The variation extends from the very slight impairment of general condition, with little constitutional disturbance and no positive physical signs of pulmonary involve-

ment, to progressive deterioration of health, with afternoon fever, various symptoms of toxemia, and marked physical signs of a progressive lesion.

Cases of the mildest type frequently respond favorably, without discontinuance of work, to a rearranged régime of life, embracing particularly longer hours of night rest, avoidance of overexertion, a more liberal diet, and abundance of fresh air. A limited period of sanatorium treatment may be advisable, however, from an educational standpoint, in a proportion of cases even of the mildest type.

As a general rule, temporary discontinuance of work and treatment in a sanatorium are indicated in the majority of active cases, and this should be continued in each individual case up to the point of arrest of the tuberculous process and restoration of the working capacity.

Early diagnosis of active cases of tuberculosis is most important from the standpoint of chances of recovery and duration, and consequently the expense of treatment.

The earlier the diagnosis the better are the chances of recovery and the shorter is the period of treatment.

3. *Increase of resistance of employees with signs of inactive tuberculosis and of those predisposed to the disease.*—Employees with signs of "closed" inactive tuberculosis (Class III), as well as those predisposed to the disease (Class IV, the anemic, poorly nourished, those with frail physique, and so on), may be classed under the general designation of "employees with low resistance." This group, forming a considerable proportion of any working force, offers a fruitful field for correction based on thorough investigation of each individual case.

Due consideration should be given in all such cases to the following factors influencing the health of the employees: first, the physical fitness of the employee for the given task (degree of exertion involved, position at work, hours, surroundings, et cetera); second, personal régime, i. e., sufficient rest, ventilation of bedroom, nourishing diet, avoidance of harmful conditions and practices, and so forth. With all these items in the personal life of the employee thoroughly analyzed by the examining physician, considerable improvement of the physical condition of an employee is often possible, even with a very slight rearrangement in his daily régime.

The task of the physician is that of a teacher of right living. Personal instruction given by him to the employee, followed by detailed home instruction by the nurse, should mark to the employee the stepping stone to better health.

4. *Instruction of the entire working force in the essentials of right living.*—Noonday or evening talks on "essentials of right living,"

"prevention of disease," and similar topics given from time to time to the entire working force, or to its separate groups, tend to the enlightenment of the worker in the essentials of health and its preservation. The interest in matters pertaining to health is rapidly increasing among working people, and a physician, speaking on this subject, to the point and in simple language, will find in them an appreciative audience.

The ultimate result of the operation of a system of medical examinations and instruction in a working place is a higher standard of health and efficiency of the working force, as well as a stronger bond of understanding between the employer and employees.

EXAMINATION OF EMPLOYEES FOR TUBERCULOSIS A PART OF GENERAL MEDICAL EXAMINATION; TIME OF THE FIRST AND SUBSEQUENT EXAMINATIONS.

Examination for tuberculosis should be a part of the general medical examination. An efficient general medical examiner of an industrial concern is fully conversant with the disease. It is desirable, however, that all medical examiners should acquaint themselves with methods of diagnosis and solution practiced in well-conducted tuberculosis clinics.

It is apparent that, in the interest of all concerned, the first examination should take place at the time of the engagement of the employee. This is being done at present, with some variations, in a few Chicago concerns. Preliminary information is obtained by means of an application blank, including questions pertaining to former and present health of the applicant, and his general appearance is scrutinized by the employment manager and the nurse assigned to his office. Suspicious cases are submitted to the physician for immediate examination. All other successful applicants are examined during the first week of their employment. Sears, Roebuck & Co. and the International Harvester Co. at present examine all their applicants for work.

In other concerns the medical examination of the employee comes with the application for membership in the Employees' Benefit Association, which includes a varying proportion of the working force. This is the case with Sears, Roebuck & Co., International Harvester Co., Montgomery Ward & Co., Commonwealth Edison Co., Chicago Telephone Co., Swift & Co., and others. Welfare departments operated by these firms also bring to the attention of the medical examiner a certain proportion of suspicious cases.

The general medical examination of an employee should be repeated at certain intervals, and also when an employee becomes sick while at work, when the appearance of the employee, or of certain symptoms, suggest the possibility of a gradually developing illness, or on return to work after a period of absence due to illness.

THE CAMPAIGN IN CHICAGO FOR EXAMINATION OF EMPLOYEES FOR TUBERCULOSIS.

Eighteen months ago I submitted to the Chicago Tuberculosis Institute a plan of examination of employees for tuberculosis. The plan is described in detail in this paper. To put the plan into operation, the institute appointed a committee on factories, the membership of which consists of myself, Dr. Henry B. Favill, and Sherman B. Kingsley, with James Minnick acting as secretary.

The important thing in Chicago, as it would be in any other city, was to interest the employer in the necessity of such examinations. The chief obstacle to the introduction of any system was the lack of information on the part of the employer that there is any such thing as a tuberculosis problem in his place, as well as the lack of appreciation on his part that any benefit can accrue to the firm through the operation of such a system.

In making the appeal to the employers we have placed emphasis on the financial loss sustained by the employer through the imperceptibly growing reduction of working power in the early stages of the disease, the danger to the entire working force from the unknown, uncontrolled " open " cases of tuberculosis, the constant infection of other workers, the subsequent loss of experienced men, and the reduction of the general efficiency of the entire working force through the existence of uncontrolled sources of infection. In our campaign we were materially assisted by the humanitarian attitude of the employers toward their workers.

Early in the campaign I devised a chart which proved of value in the conferences between the committee on factories of the Chicago Tuberculosis Institute and the employer whom we were eager to enlist. The chart, as here reproduced, shows in concentric circles the various groups of tuberculosis cases which you would expect to find in a working place, the size of the circle showing, in a general way, the relative number of workers included in each group, and the degree of shading pointing to the relative importance of the group from a sanitary standpoint:

It was very essential to make it clear to the employer that systematic examination of employees for tuberculosis will disclose not only the "open" and active cases of tuberculosis, the solution of the majority of which lies in institutional treatment, but also the larger group of workers in whom a predisposition exists, either because of latent infection or because of malnutrition, anemia, and so forth. One of the important objects of the examinations, the employer was told, is to raise the resistance of these groups through proper medical advice, education in right living, change in occupation if necessary, and in other ways. By the spread of this education in right living among the employees the final result is a higher standard of health and efficiency of the entire working force.

As result of a campaign conducted by the committee on factories of the Chicago Tuberculosis Institute during the last 18 months, systematic examination of employees for tuberculosis is at present in operation in the shops of the International Harvester Co., Montgomery Ward & Co., Chicago Telephone Co., and Swift & Co. Sears, Roebuck & Co. have for some time past paid special attention to tuberculosis as a part of the general examination.

The physicians connected with the above and other concerns meet with the committee on factories of the institute from time to time to discuss the important phases of their work, and these meetings are very important in the gradual formulation of principles and practices. At the two conferences so far held some of the subjects chosen for discussion were: "The best method of campaigning for the extension of the examination of employees to other concerns," "The time of the first examination of the employee," and "When should the examination be repeated?"

THE DETAILS OF THE PLAN OF EXAMINATION OF EMPLOYEES FOR TUBERCULOSIS.

The details of the plan submitted to the Chicago Tuberculosis Institute 18 months ago, and since then advocated under the auspices of its committee on factories, is as follows:

1. *Physician to examine all suspicious cases.*—In places with established medical service this task may be assigned to the physician on the staff of the firm. In large establishments a special tuberculosis examining physician may be necessary. In either case possession of special experience in the diagnosis of tuberculosis is very important.

Duties of the physician are the examination and diagnosis of cases; disposition of those found tuberculous; instruction of the sick in the essentials of treatment and of the predisposed in right living and in measures tending to increase the general resistance; frequent noon or evening talks to the entire working force on maintenance of health and prevention of disease.

The hours of work of the physician are determined by the extent of the problem; one, two, or more afternoons a week, or a regular daily service. Compensation should be graduated according to the amount of work and the individual qualifications.

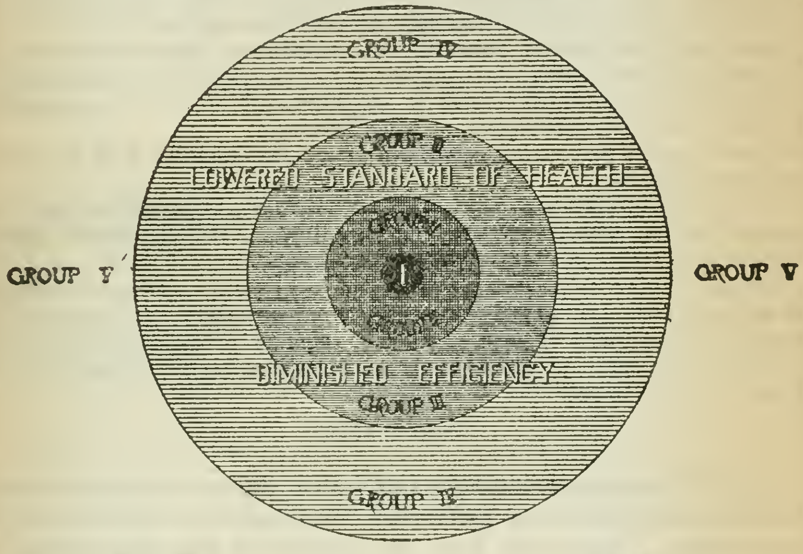
2. *Trained nurse to assist the physician.*—Duties are to assist the physician during clinic hours; to visit and study the homes and living conditions of employees pronounced tuberculous or predisposed; to instruct in the fundamentals of right living, and in the methods of care and prevention, by actual demonstration in the employee's home; to gather in each individual case information essential to its right solution.

Compensation is that of a visiting tuberculosis nurse, regulated by the responsibilities of the position and individual qualifications.

The TUBERCULOSIS PROBLEM IN A WORKING PLACE

by Theodore B. Sachs

GROUPS OF WORKERS



CONDITION

GROUP I *Tuberculous.*	*"Open"-Communicable Cases.*
GROUP II *Tuberculous.*	*Disease-Active, Progressive.*
GROUP III *Tuberculous.*	*Disease-Inactive.*
GROUP IV	*Workers With Low Resistance.*
GROUP V	*Workers in Average Health*

REMEDY

Periodic Medical Examinations.

Right Conditions for Entire Working Force.

Education of All in Right Living.

Hospital & Sanatorium Treatment for Groups I, II & part of III.

RESULT

HIGHER STANDARD *of* HEALTH AND EFFICIENCY

For Copies of This Poster Apply to the Committee on Factories of The Chicago Tuberculosis Institute

3. *Classes of cases to be examined.*—At a conference between the superintendent, the physician, and the nurse, it is agreed that the working force is to be watched for the following classes of cases:

(*a*) Employees in whom diagnosis of tuberculosis was previously made.

(*b*) Employees whose poor general condition (malnutrition, anemia, or weakness), in connection with other suspicious symptoms, suggests the possible presence of the disease.

(*c*) Employees with histories of protracted (or recurring) cough and expectoration.

(*d*) Employees in whose families or homes a case of tuberculosis exists, or in which a death from tuberculosis occurred, etc.

In large establishments a circular letter may be sent previous to the conference to all superintendents or foremen, calling attention to the abovementioned classes of cases, and explaining the object and scope of the proposed examinations.

4. *Tuberculosis clinic.*—With the compilation of a list of suspicious cases a tuberculosis clinic is established on the premises of the firm, in which all such cases are subjected to a thorough medical examination.

Each individual case is classified, (*a*) according to diagnosis, tuberculous or nontuberculous, active or nonactive, open or closed; (*b*) according to necessity of change of occupation or discontinuance of work; (*c*) according to need of hospital, sanatorium, or home treatment.

The solution of each case is considered after a full analysis of all its medical and social aspects.

At times some difficulty may be encountered in persuading an individual member of the force to undergo the examination, but, as in all matters, diplomacy and kindness will overcome all obstacles.

Besides serving as a diagnostic station the clinic maintains continuous supervision over (*a*) employees classed as predisposed; (*b*) employees returned to work, with disease apparently cured or arrested by institutional or home treatment; (*c*) employees taking home treatment and assigned to the clinic by the employer.

CONCLUSION.

Very important considerations prompted the campaign in Chicago for the introduction of systematic examination of employees for tuberculosis. They were, first, the realization that early diagnosis of tuberculosis can be best attained with a system of examination of working people that will detect the disease long before the pronounced symptoms manifest themselves and which will detect it while its victims are at work and unconscious of its presence; second, the operation of a system of examination in a working place and the knowledge of the existing conditions gained thereby eventually leads to the improvement of sanitary conditions and enlists the support by the employer of adequate and efficient institutional provision for the treatment of tuberculosis (the employers' interest in the antituberculosis campaign is of vast importance); third, the further realization on the part of the workers, employers, and the community at large of the present utter helplessness of a worker in the case of illness will lead to more comprehensive measures for the protection of the worker and his family in the case of his illness (further extension of the principle of the employees' benefit associations, workmen's insurance, and so forth).

Experience in antituberculosis work in a community teaches us that support of any element in the community can be permanently gained by a clear demonstration of the relation of that element to the existing problem, and this is becoming apparent in our present campaign in Chicago.

SUMMARY.

The aim of the described plan of examination of employees for tuberculosis is, first, detection and suppression of sources of infection in working places; second, detection of cases of the disease in the curable stages; third, guidance of all employees predisposed to the disease and of those who are reemployed after having recovered their health through sanatorium or home treatment; fourth, guidance of all employees in right living and in methods of prevention.

DISCUSSION.

Dr. Charles W. Crankshaw, physician in charge of the Prudential Infirmary of the Prudential Life Insurance Co., Newark, N. J.: Just a word in addition to the excellent papers of Drs. Price and Sachs. The physical examination of employees for all trades is not only highly commendable for the protection of fellow employees but is humanitarian. It has been my experience that in those cases where tuberculosis of the lungs has been detected you at once have an eager listener for instruction as to what to do, and one who is glad to follow your advice. In this you act as both physician and teacher, and are able to accomplish three things: First, you protect the person examined; second, the home from which he comes; and, third, the general welfare of humanity.

RESULTS OF A HYGIENIC AND SANITARY INQUIRY INTO THE ITALIAN PRINTING TRADE.

Prof. Dr. L. Carozzi, Milan, Italy.

In the course of an inquiry on the hygienic and sanitary conditions in the Italian printing trade, I have had occasion to study, during two years, about 600 printers (compositors and pressmen) and statistical tables, covering about 30 years, of many mutual societies of printers.

Modern printing establishments (with good light and ventilation) are very rare in Milan, and in the great majority of the smaller workrooms conditions are very unhygienic, so that there are factors which would produce disposition to tuberculosis. My statistical data are quite conclusive of the unfavorable effects of this occupation on health, caused, in the majority, by the confinement in unhygienic workrooms.

My observations permit me to add the following: The children begin to work in the printing trade without an accurate medical examination and at the lowest legal working age. The per cent of stillborn children and of miscarriages from parents occupied in printing trades is very high—38.2 per cent.

The average morbidity rate for all diseases among compositors and pressmen is very much higher than the average for other classes generally. The morbidity rates for workmen are very high, especially in the first years of their occupation, and the sum of the days of incapacitation from sickness is very large. The morbidity is due to respiratory and gastric complaints. The per cent of muscular and joint diseases is relatively high.

If plumbism with its classic symptoms shows a very low per cent, we must not forget that other complaints may be due to lead poisoning which is not yet recognized as such in this class of working people (especially such complaints as gout, arthritis, arteriosclerosis, and muscular and joint affections). I can say that colic is the exception rather than the rule among printers.

Diseases of metabolism, if they are not characteristic of this class, deserve special attention for their frequency among printers in comparison with other classes generally. Among nervous complaints, neurasthenia is certainly the most widespread, owing to many factors.

Type metal is an alloy of lead, antimony, and small quantities of tin and copper. My experience does not confirm the possibility of an antimony poisoning among printers. The dust in printing shops and type foundries examined has been found to contain very much lead but never antimony.

Among linotypists and pressmen we may occasionally observe a peculiar symptomatology, confirmed by the examination of the blood, and caused by the continual use of benzol, benzine, mineral oil, and benzographol [pricking, tingling, numbness in the extremities; the number of blood corpuscles is greatly increased].

Eye diseases are very frequent, and are really due to the special occupation of compositors, from a transitory spasm of the accommodation to the most severe cases of myopia.

High blood pressure is not rare, but is due to other factors besides the lead.

Accidents are relatively rare, in the majority of cases not severe, and more frequently they involve the hands and feet.

Mortality statistics confirm what I have already said. Among the causes, tuberculosis, especially of the lungs, is the most frequent, and next in order we find acute and chronic diseases of the respiratory system. The death rate from tuberculosis of the lungs is very high—33.1 per cent of the deaths from all causes and 66.1 per cent of the deaths due to respiratory diseases. Other important causes are the infections, typhoid fever, influenza, and so on. The highest death rate among printers is between the ages of 16 and 35. Consequently the average span of life for employees in the printing trade is very low.

HYGIENIC AND SANITARY INQUIRY IN SILK MILLS.

Prof. Dr. L. Carozzi, Milan, Italy.

In 1909 the factory department of inspection asked me to answer the following questions, among others: Are silk spinners really subject to organic diseases? To what other diseases are the silk spinners predisposed? What are the causes? What degree of temperature and humidity can be kept in a silk mill without being injurious to the workers?

From the examination of 300 spinners among the female employees in 25 silk mills, I have come, since 1909, to the conclusion that among the silk spinners examined no organic change occurs except in the blood. This statement concerns spinners employed under certain conditions of temperature and humidity in silk mills. I found, for instance, a remarkable increase in the number of blood corpuscles, when the relation between the wet and dry bulb thermometers in the workrooms was not that fixed by the English cotton-cloth factories act.

This hyperglobulia is perhaps simply due to an unequal distribution of the blood in the circulatory system.

I found also among these female employees a moderate chloranemia common to textile workers.

I have not sufficient data to decide as to retarded or disturbed development among the female children, but my inquiry into the history of the married women among the silk spinners examined shows a large infant-mortality rate. I think that the cause of this could also be found in other factors: Heredity, insanitary houses, insufficient food, and so forth.

It is certain that by bettering the living conditions, and especially the food, of the working class, we may better their health. It would be most inadvisable to lower the working age limit. On the contrary, it would be better to endeavor to raise it so as to prevent the employment of children until they attain the age of 18.

The conditions which I have been able to investigate in the field of industrial and social hygiene of this trade include: The construction of the mill, natural light and ventilation, flooring, the number and per cent of living and dead children, the employment of female children and married women, and the development of female employees.

THE AMERICAN MUSEUM OF SAFETY.

William H. Tolman, Director, American Museum of Safety, New York City.

In America safety and caution are not popular. "Why should I be careful? I have never been hurt yet," says the man whose experience should make him respect the potential danger of machines and processes, yet he may be the very one to be the next victim of his own bravado and folly. He may be indifferent to his own safety, but he has no right, through this carelessness and indifference, to deprive the family of his support in case of his disablement, nor at the same time to imperil his fellow workmen who may be affected by the accident.

Another class is the green, unskilled worker who enters upon his industrial life without a knowledge of the perils and risks he is to encounter. Both these classes should be "shown;" they need to see the wheels and cogs actually revolve, so that the danger may be visualized; then the necessity for caution and safety is borne in upon them. But where to go for such a practical demonstration? The employer can not do it for the community; he may not do it for even his own people. It is again the case of what is everybody's business is nobody's business.

There are four groups of interests involved in accidents arising in industrial pursuits—the workman, the employer, the community, and the people at large. The latter are involved almost exclusively as sufferers in accidents occurring in different means of transportation and may be ignored in dealing with accidents in manufacturing operations.

The community is involved, because it is very often called upon to care for those whose means of livelihood have been impaired or entirely cut off, directly or indirectly. There are those who claim that this is imposing upon the community a burden which it is the duty of the industry to bear, and we are upon fairly debatable ground.

The workman is probably the greatest sufferer, considering his means, and this has led public opinion and, in more concrete form, legislative bodies to seek relief along the least line of resistance—that of making the employer, usually possessing financial responsibility, to carry the whole load.

To reach a thorough understanding and to get a fair and honest distribution of responsibility and of contributions for relief an analysis of industrial accidents will be helpful.

There is, first, the large group, under present circumstances in this country, which is due to the inherent risks of the industry, the accidents which no foresight or care on the part of the employer or the workmen would prevent. There is a fair and should be a direct charge upon the industry which the consumer ought to be made to share in if it were possible to add a part or the whole of it to the price of the product.

Then there are the accidents due to carelessness or recklessness of workmen and their fellows, many of which are brought about by the resistance to reasonable discipline, which is a characteristic of the American workman, and many of which are caused by ignorance, for which the management can fairly be held responsible.

For accidents brought about by carelessness or recklessness the guilty should suffer, and if there be an appeal to anyone it should be to the fellow workmen. That the latter do often nobly respond as individuals we all know from our own experience; but I do not know of any systematic effort in that direction, and certainly the labor unions have never clearly recognized their duty in this respect. In fact, where they do possess the power, their exercise of it tends to increase the fatalities through their frequent tendency to weaken discipline.

The last group of accidents is that for which the employer is squarely responsible because he does not provide the necessary safeguards or because he neglects opportunities fairly within his reach to educate the ignorant, to restrain the reckless, or to secure the active cooperation of the intelligent and the well disposed. It is not enough to spend money and exercise ingenuity in equipping a plant with safety devices and in seeing that they are kept in efficient condition. It is not enough to draw up sharp rules and to see that they are obeyed. There must be developed systematically throughout the organization a spirit of cooperation from top to bottom, and that spirit of cooperation must spread over the entire industry.

Fortunately in the iron and steel industry the splendid spirit of cooperation is a powerful aid in attaining the ends sought, and that industry stands foremost as the one branch of manufacturing in which this spirit prevails. But that cooperation must be universal. The companies and their managers and associates must have the active help of everyone down to the water boy. There must be a frank and free interchange of experience and attainment by all of what reasonable regulations are promulgated. At this point the American Museum of Safety offers a clearing house of simple, practical, and efficient methods.

It comes right down to a matter of business. The country has been aroused. It has been stirred by some men and women who possess that honest enthusiasm which is unhampered by facts or checked by the rights of others. It has been stirred, too, by self-seeking demagogues. But whether it be by honest lovers of humanity or wicked scoundrels the fact remains that known and serious abuses, long continued and callous indifference have created in the public mind that feeling of exasperation and antagonism which in a country like ours spells hasty and unfair legislation against the one who is known to have money and can be bled.

The most effective means for meeting such a movement, which may become dangerous through the activity of enthusiasts and of demagogues, is to remove what just complaints and criticisms there exist.

To head off oppression or unjust legislation it behooves our manufacturers to do all in their power to reduce to a minimum the suffering due to accidents to life and limb. Even the inherent risks of occupation constitute a serious charge upon employers and employees, and these in themselves can be made a serious burden.

Our industrialists must put their house in order; they must cut the ground from under a movement which is dangerous because there is some justification for it; they must come into the forum of public opinion with clean hands. After all, it is a business proposition, however much the sentimental and humanitarian side may at first appeal for attention and sympathy.

"John won't want me now," was the recent pathetic cry of a young woman in a factory as she fell to the floor, her right arm wrenched off at the shoulder by the unguarded machine at which she was working. It was on the eve of her marriage. "John can't afford to mary a woman who is no helpmate to him."

A few years ago we were considered visionary in our advocacy of safety devices, greater caution, and the sanctity of human life, but I am glad to say that at last we are awakening to the importance of this great subject of safety, a subject that has come to stay for all time and as a right. It is our duty to surround the toiler who makes the wealth of the Nation with every possible safeguard and to protect his life and health while he is at work.

I will go still further in a demand for greater safety for the public, the man in the street, the man on his travels, the man in his home. This does not alone apply to safety devices, but to sanitation, clean streets, less noise, pure foodstuffs, pure air, light, and water—the essentials of health.

The time has passed in which it is necessary to philosophize merely and to discuss only these vital problems in the United States. The thoughtful citizenship of the land is demanding constructive action. In its efforts to provide a practical system of compensation it came up against a dead wall. It found that compensation was not the solution, but that prevention struck at the root of the evil.

Although the awakening has come, the field for activity is so great that it needs continuous application and a well-organized propaganda throughout the country. Do not make the mistake of thinking this can be done in a month or in a year; it should be a continuous influence; there should never be any let up. It is such a mighty subject that it must become part of our educational system. At present we are dependent on the teachings of other great nations; if, now, we are wise, we will let this be a guiding influence, and not think ourselves such a superior race, and so be deluded with a fatal optimism.

If now our country would escape the reproach and disgrace of being the only civilized Nation in the world to fail to provide instant and automatic relief for the sick and injured workmen, the whole Nation must stop and think; no one section, no one group, no combination of interests can remove the reproach; the awakening must be national. The selfishness of private greed and the personal interests of the politician are ever present in systematic insistence, and will become overwhelming unless the attention of the whole people is directed to our needless sacrifice of human life and efficiency.

Until such time as the consideration of safety becomes of as great importance as questions of producing, selling, advertising; until it becomes a part of a plant's industrial policy; until this point has been reached, the American industrialist will not have done all in his power to protect his industrial army, who are intrusting their lives and limbs to his keeping, at least during the working day.

To do all this, and more, too, the last decade has seen the establishment of museums of safety, where employers, workmen, and the public may go, see, and study, in actual operation, or by means of models, the simplest and best methods of protecting the dangerous parts of machines and processes, so as to safeguard the lives and limbs of the workman. The first in America has its present headquarters at 29 West Thirty-ninth Street, New York City.

A museum of safety utilizes the basic principle for preventing this waste of human life and limb, with its attendant train of sickness, misery, and poverty.

The life of the head of the family, the father, the sole breadwinner, is snuffed out by a preventable accident, leaving the wife and children stranded. The mother, in most cases an unskilled worker, must take a wage barely sufficient for her own needs; consequently charity must step in to support the children and educate them. No self-respecting workman wishes to be the recipient of charity. The stamina of children reared in charity is weakened, the moral fiber is impaired, independency is taken away; all this resulting in lowered standards of morals, education, and citizenship.

While the museum is primarily for the education of the employer and the employee, in pointing out to the former what safety devices he should install, and showing the latter how to use them when provided, there is another important function in the inculcation of safety and caution upon the community. Impairment of the wage-earning efficiency of the individual entails a social obligation, through the provision and maintenance of the hospital, with its first aid, ambulance, and other service; the children of the injured man may be compelled to leave school to go to work; charity must intervene to provide for the relief of dependent relatives. All this means an increased burden on the municipal departments of charity, health, and police.

The American Museum of Safety was incorporated by a special charter from the legislature, chapter 152 of the laws of 1911 of the State of New York:

> The objects of the corporation hereby created are to study and promote means and methods of safety and sanitation and the application thereof to any and all public or private occupations whatsoever, and of advancing knowledge of kindred subjects; and to that end to establish and maintain a museum, library, and laboratories, and their branches, wherein all matters, methods, and means for improving the general condition of the people as to their safety and health may be studied, tested, and promoted, with a view to lessening the number of casualties and avoiding the causes of physical suffering and of premature death, and to disseminate the results of such study, researches, and test by lectures, exhibitions, and other publications.

The museum is noncommercial; it is not a showroom for patented safety devices; it does not sell or take orders for any of the devices in its collections; all demonstrations are made by its own staff; and there is no charge for space. Arthur Williams is president and James Speyer treasurer.

The museum is devoted to the safety, health, and welfare of industrial workers and the technique and science of industry. With this end in view, its operations are divided into three great departments: Accident prevention, industrial hygiene, mutuality.

The exhibits in the department of accident prevention are divided into two groups:

I. General: Boilers, containers, steam piping; power machines; transmission; electricity; elevators and hoists; fire and explosions; personal equipment of workmen; miscellaneous.

II. Particular: Mining; quarrying, excavation; blast furnace and foundry; metal working; wood working; chemical industries; stones and clays; textiles and clothing; paper and printing; foodstuffs; agriculture; building trades; transportation by land; transportation by sea; first aid to the injured.

Industrial hygiene.—Apparatus and instruments for the testing of air, light, and water; exposition of substances detrimental to health; lighting; ventilation; exhaust for dust and gases; infectious diseases—tuberculosis; baths, dining rooms and clothing; water-closets and lavatories; personal equipment of the worker; miscellaneous.

Mutuality or social hygiene.—Improved dwellings; service annuities; foodstuffs; miscellaneous.

A jury of experts in each group will pass on the suitability of all exhibits, which must have safety or industrial hygienic essentials.

The museum provides demonstrators, descriptive circulars, care, and maintenance. All cost of transportation to and from the museum is at the expense of the exhibitor, and all installations to be done by the exhibitor, under the direction of the museum.

The collections are open daily, except Sundays and holidays, and are free to the public; but special visits can be made to accommodate selected groups of students or workmen.

In the museum's iron and steel section, under the chairmanship of Charles Kirchhoff, may be found every phase of safety devices, in actual models or in photographs, in use in the iron and steel and allied industries: Blast furnaces; open hearth; Bessemer; blooming, rail, skelp, slabbing, galvanizing, pipe and wire mills; power stations, yards, shops; electricity and transportation. These collections are being studied by engineers, factory inspectors, and foremen, who make drawings and tracings for use in their own plants.

By special arrangement evening conferences have been held at the museum with the New York commissioner of labor and 43 inspectors, the iron and steel electrical engineers, the du Pont Powder Works' superintendents, engineers, and chemists, New York section of Institute of Mining Engineers, National Electric Light Association, Midvale steel superintendents and foremen, Society of Hungarian Engineers, and the safety committee of the United States Steel Corporation.

The museum's library contains the most highly specialized collection of books, pamphlets, photographs, lantern slides, and special reports on safety in the country. These are the facilities to be enjoyed at the museum's headquarters. On its extension side may be mentioned field work by means of free illustrated lectures on accident prevention. The iron and steel section alone has conducted an educational campaign at mills and plants, where superintendents, works managers, engineers, and foremen have assembled to learn what has been accomplished through the introduction of safety devices in their industry. In some instances the meetings have been limited to the personnel of the particular plant, no men under the grade of foremen being present. These audiences have ranged from 300 to 2,100 men, and all have been impressed with the simple and practical character of the safeguards.

The department of industrial hygiene, under the chairmanship of Dr. N. E. Ditman, now possesses what he calls the most important collection of illustrative material in America; not dead material in books and statistical studies, but actual anatomical specimens or models in wax, showing effects of occupational diseases, and, side by side, photographs and other means for teaching concretely how these diseased conditions can be prevented. There is a growing number of industrialists who are realizing the importance of what the museum can show in methods for promoting improved hygiene along economic lines, but there is still a large number of works managers who are ignorant of what hygiene engineering would accomplish for them.

Insanitary workrooms have a direct economic bearing on the output of a plant; good sanitary conditions mean that the employer has the continuous service which results in team work. The small outlay for accident prevention and better health conditions would very quickly be made up through lessened payments for accident compensation and sick benefits. The larger industries have their own laboratories for testing the noxious qualities of old materials and for the investigation of new. But for the thousands of smaller plants an organization like the museum is a necessity.

The hygienic elevation of the masses comes within the scope of Federal, State, and city aid, but these directing forces of political and social life are almost powerless to control the sanitary habits of the individual. Educating him by demonstration and persuasion is the work of the Museum of Safety.

The rapid growth of industry has brought about a new science—industrial hygiene. Occupational diseases have been known for a long while, but scientific research as to their causes and effects is a recent activity. The fund of knowledge so far acquired has been the basis for social legislation. Social hygiene, in its newer development, is constantly evoking new facts, thanks to the diffusion of technical knowledge and the rise of new industries.

For example, the improved sanitation of woodworking shops by means of a system of exhausts for the dust from saws, planers, shapers, and other machines with rapidly revolving knives or tools is comparatively new. The Germans have just discovered that certain obscure diseases among woodworkers are due to the noxious qualities of the woods on which they work. Given exact knowledge of work conditions, the dangers are recognized and the way paved for their elimination. This, in turn, means that the inquiry must be pushed back to a study of the environments in which the workman lives; in other words, what is connoted by the term social hygiene.

ANNUAL RECOGNITION.

With a view to stimulating invention and installation of safety devices in all industries and the promotion of sanitation. certain friends of the American Museum of Safety have established prizes or awards, to be bestowed under its direction:

The Scientific American medal of the American Museum of Safety: A medal to be presented to such individual or corporation as has produced and exhibited in the American Museum of Safety, within a recent period of years, any perfected device of utility which, in the judgment of the jury of awards of said museum. best conserves human life and limb in the processes of productive industry or other vocations.

This medal has been awarded, in 1908, to the Rich Marine Fire Extinguishing Co.; in 1910, to the Patent Scaffolding Co.; and, in 1911, to the Norton Co.

The second medal is the Travelers' Insurance Co.'s medal of the American Museum of Safety: A medal to be awarded to the American employer or the manufacturing or other corporation which, in the judgment of the jury of awards of the American Museum of Safety, has, during a recent period of years, done the most or achieved greatly for the conservation of the lives and limbs of workmen by means of safety devices for machines and processes.

This medal was awarded in 1910 to the United States Steel Corporation and in 1911 to the Pennsylvania Railroad Co.

The third medal is the Louis Livingston Seaman medal of the American Museum of Safety: A medal for progress and achievement in the promotion of hygiene and sanitation and the mitigation of the evils of occupational disease. It was awarded in 1911 to Dr. A. H. Doty.

The Emil Rathenau medal has been placed at the disposal of the American Museum of Safety by the Allgemeine Electricitaets Gesellschaft, Berlin, to be awarded annually for the best device or process in the electrical industry for safeguarding industrial life and health. It was awarded for the first time at the museum's annual meeting in January, 1913, to Mr. Thomas Alva Edison.

A new medal, the E. H. Harriman Memorial Gold Medal, has been founded by Mrs. Harriman for annual award to the American steam railway making the best record in accident prevention and industrial hygiene, affecting the public and its own personnel, during the current year.

Competitors for all medals will be required to announce themselves as such at least 30 days in advance of the day on which the award shall be made public.

CONDITIONS OF THE COMPETITION.

Within the limits set by the terms of the gift of these medals, and also as a guide in accepting material for exhibition in the American Museum of Safety, the jury of awards has established requirements which must attach to exhibits and medal competitions:

1. Applicability; wide or narrow: Does the device procure safety for a large number of persons or in a great variety of conditions?
2. Practicability: It must be capable of being used economically and successfully. It must not be too cumbrous or intricate to apply or to operate.
3. Simplicity: It must not be so complicated that experts are required to handle it or to keep it in repair and operation.
4. Reliability: It must not be liable to derangement, causing failure to work in emergencies.
5. Durability: It must not be so delicate or require such fine adjustment that when installed it will not last in service.
6. Commercial availability: It must not be too expensive in first cost to install or to maintain in operation, and in general it must be obtainable by purchase in an open market for the use of all or as an article of regular manufacture.

But the accidents in industry are greatly augmented by accidents to the general public, resulting in death, maiming, and loss of health. The toll of street accidents is alarming and presses for immediate remedies. For the nine months ending September 1 there were killed on the streets of New York City 339 persons; of this number, 117 deaths were due to wagons, 86 to street cars, and 136 to automobiles. The greatest number of these casualties affected the children. These figures are an increase of 100 per cent over the casualties for the same period last year. Large numbers of children are daily exposed to street perils.

Every year in New York City some 40,000 children leave the two upper grades to go to work. Safety and caution should be implanted in the minds of these young people before they leave school, so that their wage-earning capacity may be conserved for themselves, their families, their employers, and their city. The museum has perfected plans to carry this safety and caution work into the public schools.

In the summer of 1912, with the consent of Hon. William H. Maxwell, Superintendent of the Board of Education for New York, several classes of vacation school children, accompanied by their teachers, visited the American Museum of Safety. The delight and interest of the children, who wanted to come again, and the indorsement by their teachers of the demonstration of devices and the manner in which the subjects of safety and caution were presented, indicated the success of this educational experiment. The children absorbed the instruction given and replied with intelligence to the questions asked them with a view to determining if they understood the use and purpose of the devices shown them.

In the following December the museum, having received formal authorization from the board of education, carried its educational campaign for safety into the schools of the city. The museum's representatives visit the various schools and talk to the children, generally in assembly, illustrating the little stories of accidents and suggestions for caution on the streets with graphic charts and models of devices that are on exhibit at the museum. At the close of each Safety talk neat and attractive buttons bearing the insignium of the American Museum of Safety are left with the principal of the school for distribution among the children. The wearing of this button makes the child a member of the Museum's Safety League. At intervals the badges are followed by safety leaflets or stories on the special dangers of street cars, electricity, gas, automobiles, and matches, which have proved very interesting to the children and, in some instances, have served as the basis for exercises in composition and drawing. The parochial and private schools are included in this educational work, adding 150,000 children more to the 700,000 boys and girls in the regular public-school system of New York.

Accident prevention is primarily a matter of education, and the hope for the future lies in training the child to think and to act along lines of safety and caution on the street, in the shop, and at home.

There are now 22 museums of safety and institutes for the special study of industrial hygiene in Amsterdam, Barcelona, Berlin, Brussels, Budapest, Copenhagen, Dresden, Frankfort on the Main, Gratz, Helsingfors, Milan, Montreal, Moscow, Munich, New York, Paris (safety), Paris (hygiene), St. Petersburg, Stockholm, Vienna, Wurzburg, and Zurich. The American Museum of Safety in New York City is the only one in the United States.

The American Museum of Safety felt that the time had come for an international organization, which was set in motion this summer. The headquarters of this "world clearing house for safety" will be at the Institute of Industrial Hygiene at Frankfort on the Main, under the secretary generalship of Dr. Francke. Prof. Dr. Leymann, of the ministry of the interior, has accepted the presidency. On the board of vice presidents the United States is represented by Arthur Williams, president of the American Museum of Safety.

The trustees of the museum feel that their continuous concerted educational work has been a large factor in focusing the attention of the country upon the need of the more adequate adoption of safety devices and the provision for industrial hygiene. It is, therefore, impossible to estimate the wide-reaching influence of the inspirational force of the American Museum of Safety.

From this presentation of facts the American Museum of Safety stands to-day as the exponent of things done. It is the only concerted, organized effort in the United States for demonstrating, at the museum itself, the use of safeguards there collected; for bringing to the industrialists the knowledge of these devices, by means of manuals and leaflets of safety, special report service, and illustrated lectures. Such an institution is available for study visits by the teachers and scholars in our public schools. Its scope is twofold, namely, the education of the employees already at work and the inculcation of these principles of safety and caution in the minds of the coming generation of wage earners.

To accomplish the widest usefulness for this magnificent life-saving station, so that its practical help may be freely brought to every man, woman, and child in the United States, it should be housed under its own roof, with adequate resources for maintaining, at their highest efficiency, the three great departments of accident prevention, industrial hygiene, and mutuality. Such an institution should be for all; it should be free; it should be absolutely nonpartisan, noncommercial, and nonreligious. In the establishment of this Museum of Safety for New York State and City there is an opportunity, as never before in the history of the Western Continent, of building such a memorial as will stand for all time to all the other States of the Union, and to the entire world, as an object lesson in the conservation of human life, our most precious civic social asset.

DIE STÄNDIGE AUSSTELLUNG FÜR ARBEITERWOHLFAHRT IN CHARLOTTENBURG. (ANSTALT DES DEUTSCHEN REICHS.)

Von dem technischen Leiter der Ausstellung, Dr. Ing. h. c. Konrad Hartmann, Senatspräsident im Reichsversicherungs-Amt, Honorar-Professor der Kgl. Technischen Hochschule zu Berlin, Kaiserl. Geheimer Regierungsrat. Berlin—Grunewald.

Die Technik des Arbeiterschutzes ist verhältnismässig jung, sie hat sich aber in den letzten 20 Jahren hervorragend entwickelt, und es fehlt daher nicht an zweckmässigen Einrichtungen zur Verhütung von Unfällen und Gewerbekrankheiten. Zur allgemeinen Anwendung solcher bewährter Vorkehrungen ist aber eine möglichst umfassende Verbreitung der Kenntnis solcher Schutzmittel erforderlich. Besser als die Literatur vermögen Ausstellungen und Museen diese Aufgabe zu erfüllen. Es ist daher seit vielen Jahren die Forderung immer eindringlicher erhoben worden, solche Veranstal-

tungen und zwar solche dauernder Art, also Museen oder ständige Ausstellungen zu gründen.

Im Jahre 1890 wurde das von dem rühmlichst bekannten Zentralgewerbeinspektor Dr. Migerka geschaffene Gewerbehygienische Museum in Wien eröffnet, kleinere Museen entstanden in Zürich und Amsterdam.

In Deutschland reichen die Vorläufer der Ständigen Ausstellung für Arbeiterwohlfahrt in die siebziger Jahre des verflossenen Jahrhunderts zurück. Sammlungen von empfehlenswerten Einrichtungen des Arbeiterschutzes wurden an verschiedenen Orten vorgeführt.

Im Reichsversicherungsamt wurde 1887 von seinem technischen Mitgliede, dem früheren Preussischen Gewerberat Reichel eine Sammlung für Unfallverhütung eingerichtet, in der im wesentlichen von Fabrikanten angebotene Schutzvorrichtungen zur Ausstellung gebracht wurden. Auch die bald darauf in Berlin errichtete Zentralstelle für Arbeiterwohlfahrtseinrichtungen begründete eine für ihr besonderes Gebiet wertvolle Sammlung. Mehr aber als alle diese Veranstaltungen wurde von Bedeutung die Deutsche Allgemeine Ausstellung für Unfallverhütung vom Jahre 1889, die weitesten Kreisen die Wichtigkeit der vorbeugenden Arbeiterfürsorge vor die Augen führte.

Seit dieser in hohem Masse erfolgreichen Ausstellung ist in Deutschland der Wunsch nach einer ständigen Ausstellung für Arbeiterwohlfahrt nicht mehr verstummt. Die deutsche Volksvertretung brachte der Frage ein stetig wachsendes Interesse entgegen. Als eifrige Wortführer des Planes können der damalige Abgeordnete, nachmalige preussische Handelsminister Möller und der Kommerzienrat Rösicke genannt werden, der bereits für die Ausstellung für Unfallverhütung des Jahres 1889 die treibende Kraft gewesen war. Von ausschlaggebender Bedeutung war die Reichstagsverhandlung vom 28. Januar 1899, in der gelegentlich der Beratung des Etats für das Reichsamt des Innern Redner der verschiedensten Parteien, darunter ausser den Vorgenannten der bekannte Sozialpolitiker Professor Dr. Hitze, der Freiherr von Stumm und der Abgeordnete Wurm sich lebhaft für die Verwirklichung des Gedankens aussprachen, ohne von irgendeiner Seite einem Widerspruch zu begegnen.

Diesem einmütigen Wunsche des Reichstages folgte die Berücksichtigung durch den Bundesrat unmittelbar.

Die Kosten für die Einrichtung, Unterhaltung und Verwaltung der Ausstellung wurden anstandslos bewilligt. Sie betrugen für den Bau in seiner gegenwärtigen Gestalt einschliesslich eines im Jahre 1908 fertiggestellten Erweiterungsbaues 744,500 M., sodass einschliesslich der Kosten für Grund und Boden der Gesamt auf-wand für die Erstellung des Gebäudes 1,222,500 M. betragen hat. Die für die Verwaltung aufgewendeten Kosten belaufen sich zur Zeit jährlich auf 45,000 M.

Die Baulichkeiten setzen sich aus dem Verwaltungsgebäude und der Ausstellungshalle zusammen, die miteinander durch einen Vorraum verbunden sind, über dem sich der Hörsaal befindet. Das Verwaltungsgebäude enthält ausser den Büroräumen und der Wohnung des Hausverwalters im oberen Stocke Räume für Sonderausstellungen. Der 196 Sitzplätze fassende Hörsaal ist hauptsächlich für Vorträge aus dem weiten Gebiete der Arbeiterwohlfahrt bestimmt. Die Ausstellungshalle, die zur ebenen Erde einen Ausstellungsraum von 2531 qm. zur Verfügung stellt, ist mit einer Galerie versehen, die eine Ausstellungsfläche von 1212 qm. bietet.

Die Eröffnung der Ausstellung erfolgte am 18. Juni 1903 durch den damaligen Staatssekretär des Innern Grafen von Posadowsky-Wehner.

Für die innere Ausgestaltung der Ausstellung war der Weg gewiesen, den der Herr Staatssekretär des Innern im Reichstage mit markanten Linien vorgezeichnet hatte. Nicht um eine Ausstellung des Reiches sollt es sich handeln, sondern um eine unter der Leitung des Reiches von Erfindern und Fabrikanten veranstaltete Ausstellung; nicht ein Museum toter Gegenstände sollte geschaffen werden, sondern eine Ausstellung voll Leben und Bewegung. Wo immer die Möglichkeit bestand, Maschinen in natürlicher Grösser und im Betriebe vorzuführen, war von der Ersetzung durch Modelle abzusehen, die doch niemals—auch nicht für die Anschauung—einen vollen Ersatz bieten können. Wo Altes durch besseres Neues verdrängt wird, soll das Alte dem Neuen den Platz räumen, damit die Ausstellung stets mit der Entwickelung des praktischen Lebens gleichen Schritt halten kann. So wird die Besucher in der Ausstellungshalle nicht die feierliche Stille eines Museums umfangen, in dem ihnen wertvolle Dokumente menschlichen Geistes aus vergangener Zeit gezeigt werden, sondern das Geräusch der Transmissionen, das Surren der Räder wird an ihr Ohr klingen, die Musik, die, alles übertönend, in tausend und abertausend Betrieben die gewerbliche Arbeit begleitet.

Bei der Zulassung der Ausstellungsgegenstände ist die Verwaltung nach den eben bezeichneten Grundsätzen verfahren, wesentlich unterstützt hierin von einem ihr beigegebenen Beirat.

Nach dem der Ausstellung zugrunde liegenden Gedanken, nicht nur das Gebiet der Unfallverhütung, sondern vielmehr das der gesamten Arbeiterwohlfahrt zu umfassen, zerfällt sie in zwei grosse Abteilungen.

Die grössere Abteilung ist der Darstellung des Unfallschutzes in den verschiedensten Industriezweigen und in der Landwirtschaft gewidmet. Es ist davon ausgegangen, dass nur solche Einrichtungen vorgeführt werden, die bereits in den Betrieb Eingang gefunden haben, so dass sie in der Tat ein Bild von dem augenblicklichen Stande der Unfallverhütungstechnik gewähren. Ferner ist besonderer Wert darauf gelegt worden, die Sicherheitseinrichtungen soweit wie möglich in betriebsmässiger Ausführung zu zeigen. Bei manchen Einrichtungen musste allerdings mit Rücksicht auf die Raumverhältnisse auf die Vorführung in der ihrer praktischen Verwendung entsprechenden Grösse abgesehen und die Darstellung durch Modell, Zeichnung oder Photographie gewählt werden. Auch sonst musste, um ein möglichst vollständiges Bild der Unfallverhütungstechnik bieten zu können, diese Darstellungsweise mehrfach zu Hilfe genommen werden. Bei der Vorführung von Einrichtungen der Unfallverhütung in natürlicher Grösse wurde ferner darauf gehalten, dass diese Vorkehrungen, soweit es im Rahmen einer Ausstellung durchführbar ist, unter denselben Arbeitsbedingungen gezeigt werden, wie sie der praktische Betrieb ergibt. Es sind daher nahezu alle in betriebsmässiger Form vorgeführten Maschinen, deren Gesamtzahl zur Zeit etwa 200 beträgt, mit Kraftantrieb versehen, soweit sie nicht für Handbetrieb eingerichtet sind. Mehrere grössere Elektromotoren treiben je eine Transmissionswelle, von der aus die Maschinen durch Riemen bewegt werden. Ausserdem sind zahlreiche Elektromotoren für den direkten Antrieb einzelner Maschinen und Modelle angeordnet.

Die im Betrieb vorgeführten Maschinen sind sämtlich im unteren Teile der Ausstellungshalle aufgestellt; auf der Galerie haben zahlreiche Apparate, Modelle und Abbildungen Platz gefunden.

Die zweite Hauptabteilung der Ausstellung umfasst das Gebiet der Gewerbehygiene und der mit ihr in den vielfachsten Beziehungen stehenden sozialen Hygiene. Es handelt sich hier einmal um die Vorführung wissenschaftlicher Instrumente, anatomischer Präparate und verwandter Darstellungen, dann aber wesentlich auch um die Vorführung solcher Einrichtungen, die, wie z. B. die Einrichtungen zur Beseitigung gesundheitsschädlicher Beimengungen der Luft in Staub- und Gasform, die Arbeiter gegen krankmachende Einflüsse schützen sollen, um Bade- und Wascheinrichtungen, Speise- und Ankleideräume in Fabriken und sonstige der Gesundheitspflege in Betrieben dienende Veranstaltungen. Auch der Ernährungsfrage, dem Wohnungswesen und der übrigen Fabrikwohlfahrt im weitesten Sinne sind besondere Darstellungen gewidmet.

Um den Besucher auf die insbesondere der Unfallverhütung dienenden Teile der ausgestellten Gegenstände sofort aufmerksam zu machen, sind diese Teile durch roten Anstrich kenntlich gemacht.

Für die der Ableitung von gesundheitsschädlichen Staubteilen, Dämpfen und Gasen dienenden Vorrichtungen ist ein blauer Anstrich gewählt worden, um auch sie leicht erkennbar zu machen.

Sämtliche Ausstellungsgegenstände sind mit kurzen erläuternden Beschreibungen versehen, die bei den Photographien auf diesen selbst angebracht sind, während sie bei den Maschinen, Apparaten und Modellen in Form loser Blätter zum Mitnehmen ausliegen. Den Besuchern werden Heftdeckel mit einem metallenen Schnellhefter kostenlos zur Verfügung gestellt. Mit ihrer Hilfe kann sich jeder nach seinen eigenen Wünschen eine Auswahl der ausliegenden Blätter zusammenstellen. Ausserdem gibt die Verwaltung einen jährlich neu bearbeiteten Katalog heraus, in dem sämtliche Aussteller mit kurzer Angabe des Ausstellungsgegenstandes, nach einzelnen Gruppen geordnet, aufgeführt sind. Der Katalog steht den Besuchern ebenfalls kostenlos zur Verfügung.

Von den im Obergeschosse des Verwaltungsgebäudes zur Verfügung stehenden Räumen sind zwei zur Zeit dem "Deutschen Zentralkomitee für Lungenheilstätten" für eine Ausstellung überlassen, in der alles das zusammengestellt ist, was sich auf die Tuberkulosebekämpfung ausserhalb der Fabrik bezieht. Ein dritter Raum beherbergt zur Zeit eine vom "Deutschen Verein gegen den Missbrauch Geistiger Getränke" veranstaltete Ausstellung von Einrichtungen und Schriften zur Bekämpfung des Alkoholmissbrauchs.

Die Ständige Ausstellung für Arbeiterwohlfahrt ist eine Reichsanstalt und untersteht als solche dem Reichsamte des Innern. Die Verwaltung und Leitung erfolgt ehrenamtlich und zwar die Verwaltung durch Dr. Leymann, Geheimer Regierungsrat und vortragender Rat im Reichsamte des Innern, die Technische Leitung durch den Dr. Ing. h. c. Hartmann, Senatspräsident im Reichsversicherungsamte, Geheimer Regierungsrat, Honorar-Professor der Kgl. Technischen Hochschule zu Berlin.

Als Hilfsarbeiter sind tätig Professor Dr. Albrecht, Geschäftsführer der Zentralstelle für Volkswohlfahrt, Dipl.-Ingenieur Ernst, Königlicher Regierungsbaumeister.

In der Ausgestaltung der Ständigen Ausstellung wird die Leitung wesentlich von einem Beirat unterstützt, dessen Aufgabe es ist, bei der Ausgestaltung und Nutzbarmachung der Ausstellung mitzuwirken; er wird je nach Bedarf einberufen.

Vorsitzender des Beirats ist Dr. Casper, Excellens, Wirklicher Geheimer Rat, Direktor im Reichsamte des Innern. In diesen Beirat wurden berufen Vertreter des Kgl. Preussischen Handelsministeriums, des Reichsversicherungsamts (darunter auch mehrere Arbeitervertreter) und des Kaiserl. Gesundheitsamts, der staatlichen Gewerbeaufsicht aus mehreren Bundesstaaten, der Berufsgenossenschaften und ihrer technischen Aufsichtsbeamten, der Zentralstelle für Volkswohlfahrt und der Ständigen Ausstellungskommission für die Deutsche Industrie.

Um den einzelnen Mitgliedern des Beirats mehr Gelegenheit zur Betätigung zu geben, andererseits auch, um die Sachkenntnis und den Einfluss der Mitglieder im Interesse der Ausstellung nutzbar zu machen, ist der Beirat in einzelne Fachkommissionen geteilt. Diese Fachkommissionen werden je nach Bedarf einberufen und unterziehen gemeinschaftlich mit der Technischen Leitung die ihnen zugewiesene Gruppe von Ausstellungsgegenständen einer eingehenden Prüfung nach der Richtung, ob das Vorhandene zur gegebenen Zeit noch der Entwickelung der Praxis auf dem betreffenden Gebiet entspricht. Ferner sollen sie aus ihrer praktischen Erfahrung heraus auf Neuerungen, die etwa der Technischen Leitung nicht bekannt geworden sind, aufmerksam machen und gegebenenfalls bei der Heranziehung solcher Gegenstände mitwirken.

Zur Zeit bestehen neun Kommissionen, und zwar für Allgemeines und Transportwesen, Bergbau, Hüttenwesen, Metallbearbeitung, Holzbearbeitung, Chemische Industrie, Industrie der Nahrungs- und Genussmittel, Textil- und Bekleidungsindustrie, Baugewerbe, Gewerbehygiene, Soziale Wohlfahrtseinrichtungen.

Unter dem Personal befinden sich zwei Werkmeister, die als Führer durch die Ausstellung während der Besuchszeiten jedem Besucher unentgeltlich zur Verfügung stehen.

Die Ausstellungsgegenstände sind in 32 Gruppen in den Ausstellungsräumen untergebracht.

Ende des Jahres 1910 betrug die Anzahl der Aussteller und der von ihnen ausgestellten Gegenstände etwa:

Gruppe.		Anzahl der Aussteller.	Anzahl der Ausstellungsgegenstände.			
			In Natürlicher Grösse.	Als Modell.	In Zeichnung und Photographie.	Zusammen.
1	Dampfkessel, Dampfgefässe, Dampfleitungen	40	68	.....	33	101
2	Kraftmaschinen	44	9	7	44	60
3 4	Transmissionen und elektrische Kraftübertragung Elektrotechnik } bisher vereinigt	57	54	14	32	100
5	Fahrstühle und Hebezeuge	60	32	13	54	99
6	Schutz gegen Feuers- und Explosionsgefahr	32	34	4	23	61
7	Persönliche Ausrüstung des Arbeiters gegen Unfallgefahr (vgl. auch Gruppe 28)	46	70	.....	35	105
8	Verschiedenes	8	10	.....	.....	10
9	Bergbau, Steinbrüche und Gräbereien	45	60	24	58	142
10	Hüttenwesen, Giesserei	18	6	13	34	53
11	Metallbearbeitung	50	45	12	48	105
12	Holzbearbeitung	38	35	15	23	73
13	Chemische Industrie	27	36	5	17	58
14	Industrie der Steine und Erden	8	8	7	14	29
15	Textil- und Bekleidungsindustrie	39	30	11	38	79
16	Papierindustrie und polygraphische Gewerbe	17	10	.....	14	24
17	Industrie der Nahrungs- und Genussmittel	52	20	6	71	97
18	Land- und Forstwirtschaft	17	24	2	43	6

Gruppe.		Anzahl der Aussteller.	Anzahl der Ausstellungsgegenstände.			
			In Natürlicher Grösse.	Als Modell.	In Zeichnung und Photographie.	Zusammen.
19	Bauwesen	20	18	7	20	45
20	Transport zu Lande	20	13	12	20	45
21	Schiffahrt	9	10	2	13	25
22	Erste Hilfe bei Unfällen	15	15	2	4	21
23	Wissenschaftliche Apparate zur Untersuchung von Luft, Helligkeit usw	12	25	....	....	25
24	Darstellungen durch den Gewerbebetrieb bedingter Gesundheitsschädigungen und ihrer Ursachen	1	[1] 60	....	....	60
25	Einrichtungen zur Lüftung und Freihaltung der Arbeitsräume von Staub und Gasen	61	32	20	51	103
26	Wasch- und Badeeinrichtungen, Ankleide- und Speiseräume nebst Einrichtungsgegenständen	24	23	5	12	40
27	Abortanlagen	2	10	....	....	10
28	Verschiedene Einrichtungen zur Verhütung von gewerblichen Erkrankungen	11	15	1	2	18
29	Persönliche Ausrüstung des Arbeiters zum Schutze gegen Gesundheitsschädigungen	23	40	....	14	54
30	Wohnung und Unterkunft	24	....	9	62	71
31	Ernährung	20	27	2	10	39
32	Andere Fürsorge- und Wohlfahrtseinrichtungen	16	....	4	43	47
	Zusammen	856	839	197	822	1,858

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[1] Sechzehn Darstellungen.

Unter Berücksichtigung der im Jahre 1911 erfolgten Neuerungen und Auswechslungen betrug die Anzahl der Aussteller und der von ihnen ausgestellten Gegenstände am Ende des Jahres 1911 etwa:

	Aussteller.	Ausstellungsgegenstände.			
		In Natürlicher Grösse.	Als Modell.	In Zeichnung und Photographie.	Zusammen.
Vorhanden Ende 1910 (vgl. Tab.)	856	839	197	822	1,858
Neue Gegenstände von bereits vertretenen Ausstellern, ohne Berücksichtigung des Austauschs gegen veraltete Gegenstände	....	25	3	19	47
Neue Gegenstände von bislang nicht vertretenen Ausstellern	82	111	27	80	218
Demnach vorhanden Ende 1911	938	975	227	921	2,123

Die bei der Begründung der Ausstellung vom Reichsversicherungsamt überwiesene Sammlung von etwa 1000 photographischen Aufnahmen der verschiedensten Schutzvorrichtungen gegen Unfälle ist von Grund aus erneuert. Wie bei den in natürlicher Form augestellten Maschinen und Apparaten sind auch bei den neuen Photographien die der Unfallverhütung dienenden Teile rot, die der Ableitung gesundheitsschädlicher Luftbestandteile dienenden Vorrichtungen blau übermalt. Es ist hierdurch auch dem Nichtfachmanne wesentlich erleichtert, sich zurechtzufinden.

Ein interessantes Vergleichsmaterial zu dieser Sammlung bietet eine Serie von gleichfalls etwa 1000 photographischen Aufnahmen, die Unfallverhütungsvorrichtungen in den Vereinigten Staaten von Nordamerika darstellen. Die Sammlung bildete einen Ausstellungsgegenstand der Internationalen Hygieneausstellung Dresden 1911 und wurde nach Schluss derselben durch Herrn Dr. Tolman, Direktor des Museum of Safety in New York, in freundlichster Weise der Ständigen Ausstellung für Arbeiterwohlfahrt überwiesen.

Genaue Angaben über die in den einzelnen Gruppen ausgestellten Maschinen und Gegenstände sowie über die Aussteller finden sich in dem von der Verwaltung jährlich neu herausgegebenen Kataloge, der auf Wunsch unentgeltlich zur Verfügung steht.

Die Ausstellungsbedingungen sind folgende:

1. Zur Ausstellung zugelassen sind solche Einrichtungen zur Unfallverhütung und sonstige Vorkehrungen zum Schutze von Leben und Gesundheit sowie zur Förderung der sozialen Lage der Arbeiter, die von den Ausstellern in ihren Betrieben eingeführt sind oder fabrikmässig hergestellt werden.

2. Der Raum für die Ausstellung der benannten Gegenstände wird unentgeltlich zur Verfügung gestellt.

3. Ueber die Zulassung der auszustellenden Gegenstände entscheidet—erforderlichenfalls nach Anhörung des vom Reichskanzler berufenen ständigen Beirats von Sachverständigen—die dem Reichsamte des Innern unterstellte Verwaltung.

4. Die Gegenstände können in Photographie, Zeichnung, Modell oder in natürlicher Grösse und die Maschinen im Betriebe vorgeführt werden.

Die hierzu erforderliche Kraft wird kostenlos zur Verfügung gestellt.

5. Die Verwaltung übernimmt:
   (*a*) Die Sorge für die der Belehrung der Besucher Rechnung tragende Vorführung der Maschinen.
   (*b*) Die Anfertigung und Drucklegung der den Ausstellungsgegenständen beizugebenden Erläuterungen, für welche die Unterlagen von den Ausstellern zu liefern sind.
   (*c*) Die Bewachung und die Instandhaltung der Ausstellungsgegenstände.
   (*d*) Die Verwaltung haftet für die Beschädigungen der Ausgestellten Gegenstände durch Feuer.

6. Den Ausstellern liegt die Anbringung einer entsprechenden Bezeichnung der Ausstellungsgegenstände durch ein nach Vorschrift der Verwaltung herzustellendes Firmenschild ob.

7. Die Verwaltung trägt keine Verantwortlichkeit für etwaige Diebstähle oder für Beschädigungen, die den Gegenständen ohne Verschulden der Angestellten der Ausstellung zugefügt werden.

8. Die Ausstellungsgegenstände können jederzeit nach vorausgegangener schriftlicher Benachrichtigung der Verwaltung zurückgenommen werden.

9. Sofern sich ergibt, dass die in der Ausstellung befindlichen Maschinen, Apparate und Einrichtungen durch neuere Erfindungen überholt sind oder dass sie sich in der praktischen Anwendung als nicht zweckmässig erweisen, oder sofern sonst Gründe vorliegen, welche die Entfernung eines Ausstellungsgegenstandes wünschenswert erscheinen lassen, sind die Gegenstände auf Ersuchen der Verwaltung zu entfernen.

10. Die Kosten für Hin- und Rücktransport der Ausstellungsgegenstände fallen den Ausstellern zur Last. Die Montage der Maschinen, Apparate u. s w. ist von den Ausstellern zu bewirken; die der Ausstellung zur Verfügung stehenden Arbeitskräfte werden dabei nach Möglichkeit hilfreiche Hand leisten.

Der Besuch der Ausstellung hat sich in recht erfreulicher Weise entwickelt. Die überwiegende Mehrzahl der Besucher stellt natürlich Berlin und seine nächste Umgebung, doch ist besonders in den letzten Jahren der Besuch von ausserhalb, insbesondere auch vom Ausland, ein bemerkenswert hoher. Um den Besuch der Ausstellung für die Besucher so nutzbringend wie möglich zu gestalten, stellen sich die Beamten der Ausstellung, soweit es irgend durchführbar ist, persönlich zur Verfügung, um Gruppen von Besuchern, die sich zu diesem Zwecke vorher anmelden, zu führen und ihnen die wünschenswerten Erläuterungen zu geben.

Es wird auch durch gelegentliche Hinweise in der Presse und durch persönliche Beziehungen der Mitglieder der Verwaltung nach Möglichkeit darauf hingewirkt, Fachvereinigungen, die Teilnehmer an Fortbildungskursen aller Art, die Studierenden an höheren und mittleren Lehranstalten und vor allem auch die Arbeiterkreise zu solchen gruppenweisen Besichtigungen der Ausstellung anzuregen.

Auf Anregung des Reich'sversicherungsamts senden die Berufsgenossenschaften, also die zur Durchführung der Unfallversicherung errichteten Vereinigungen der Betriebsunternehmer, ihre Beamten zum Studium nach der Ausstellung.

Ebenso dient die Ausstellung den Beamten der staatlichen Gewerbeaufsicht zur Kenntnisnahme der Neuerungen in der Arbeiterschutztechnik. Regelmässige Führungen werden ferner u. a. veranstaltet von der Zentralstelle für Volkswohlfahrt, ferner für die Hörer der Königlichen Technischen Hochschule zu Berlin, der Königlichen Kriegsakademie, sowie zahlreicher Fortbildungsschulen.

Im Berichtsjahre 1911 wurde die Ausstellung von insgesamt 26,253, und zwar von 25,257 männlichen und 996 weiblichen Personen besucht.

Die Bibliothek der Ständigen Ausstellung für Arbeiterwohlfahrt zählt gegenwärtig rund 600 Bände. Ihrem Zwecke entsprechend enthält sie in der Hauptsache nur Werke, die das Gebiet des Unfallschutzes, der Gewerbehygiene und der sozialen Hygiene behandeln.

Daneben ist eine Auslage von Fachzeitschriften und Verwaltungs- und Jahresberichten der Berufsgenossenschaften eingerichtet. Die Jahresberichte der Berufsgenossenchaften enthalten wertvolle Angaben über neu eingeführte, brauchbare Schutzvorrichtungen und ermöglichen dadurch ein gründliches Studium der Neuerungen.

Bibliothek und Fachzeitschriftenauslage stehen während der Besuchszeit jedem Besucher unentgeltlich zur Verfügung. Auch werden die Bücher nach vorherigem Ausweis und gegen Empfangsbescheinigung auf kurze Zeit ausgeliehen.

Die Bedeutung der Ständigen Ausstellung für Arbeiterwohlfahrt für weitere Kreise erhellt auch daraus, dass die Verwaltung vielfach um Auskunft angegangen wird, die sich namentlich auf die Nennung von Bezugsquellen für bewährte Einrichtungen der Unfallverhütung und der Gewerbehygiene beziehen. Zur eigenen Orientierung sowie besonders, um den einzelnen Gewerbetreibenden zu ermöglicher, sich ohne zeitraubende Umfragen bei einzelnen ihm gerade bekannten Firmen über die Preise, Bezugsbedingungen u. s. w. von Maschinen und Apparaten zu orientieren, ist eine Auslage von Prospekten und Katalogen von Firmen eingerichtet, die als Bezugsquellen in Betracht kommen können. Diese Auslage ist der Bibliothek angegliedert und steht wie diese jedem Besucher während der Besuchszeit der Ausstellung unentgeltlich zur Verfügung.

Von besonderem Werte für diese Sammlung ist das von Herrn Professor Dr. Schlesinger gelegentlich der Bearbeitung seines Werkes "Unfallverhütung und Betriebssicherhert" gesammelte Material, das dieser freundlichst zur Verfügung stellte. Ebenso hat Herr Senatspräsident Prof. Dr. Ing. h. c. K. Hartmann eine schon früher angelegte Sammlung dieser Art bereitwilligst überlassen.

Der 196 Sitzplätze fassende Hörsaal des Verwaltungsgebäudes dient vornehmlich zur Veranstaltung von Vorträgen. Es werden von Zeit zu Zeit allgemeinverständliche Vorträge über solche Themata gehalten, die mit den Zielen der Ausstellung in engerem Zusammenhange stehen.

Auch sonst wird der Hörsaal bei geeigneten Anlässen für Vortragszwecke nutzbar gemacht, so z. B. zur Abhaltung des von dem Herrn Minister für Handel und Gewerbe alljährlich veranstalteten Informationskursus für Gewerbeaufsichtsbeamte, wobei die Ausstellung selbst ein willkommenes Demonstrationsmaterial liefert.

Ferner werden des öfteren in Ergänzung von grösseren Gruppenführungen kurze Besprechungen über das in der Ausstellung

Vorgeführte abgehalten, wobei ein oft lebhafter Meinungsaustausch über Vorzüge oder Nachteile einer gerade besonders interessierenden Sicherheitseinrichtung stattfindet. Der Verwaltung werden hierdurch gleichzeitig wertvolle Anregungen für Aenderungen, Neubeschaffung u. s. w. geboten.

Die Verwaltung ist seit der Begründung der Ausstellung des öfteren in die Lage gekommen, sich an auswärtigen Ausstellungen zu beteiligen.

Das erste Mal war dies der Fall gelegentlich der 1904 veranstalteten Ausstellung für Unfallschutz und Gewerbehygiene in Luxemburg, bei welcher Gelegenheit zahlreiche Photographien von Schutzvorichtungen ausgestellt wurden. Im gleichen Jahre wurde auf der Weltausstellung in St. Louis durch geeignete Photographien auf die Bestrebungen und das Wirken der Ausstellung hingewiesen. Sodann brachte die Verwaltung gelegentlich der Eröffnung des Museums des Grossherzoglich Badischen Tuberkulosevereins in Karlsruhe in November 1904 den Staubschutz in Fabrikbetrieben in Modellen, Zeichnungen und einzelnen betriebsfähigen Absaugungsvorrichtungen zur Darstellung. An der vom August bis Oktober 1907 währenden Internationalen Ausstellung für Unfallverhütung, Gewerbehygiene und Arbeiterwohlfahrt in Budapest beteiligte sich die Ständige Ausstellung für Arbeiterwohlfahrt durch eine Sammlung von 650 Photographien, die den Arbeiterschutz zur Darstellung brachten. Diese Sammlung wurde nach Schluss der Budapester Ausstellung dem Königlich Ungarischen Sozialmuseum in Budapest zur Bereicherung der dortigen Sammlung überwiesen.

In der Internationalen Hygieneausstellung in Dresden 1911 ist die Ständige Ausstellung für Arbeiterwohlfahrt in einer Gruppe von Photographien vorgeführt worden, die ein Bild von der baulichen Anlage und der inneren Ausgestaltung gab. Eine Schrift erläuterte Zweck, Umfang und Inhalt der Ausstellung.

Die Ständige Ausstellung hat auch für das Ausland Bedeutung erlangt. Alljährlich kommen Hunderte von Ausländern zum Studium nach der Ausstellung und nach ihrem Vorbilde sind in Paris, Stockholm, Budapest, Moskau, New York Museen gegründet worden, die der Förderung der Technik des Arbeiterschutzes und der Arbeiterwohlfahrt dienen.

Die Ausstellung ist geöffnet: An den Wochentagen (mit Ausnahme des Montags) vormittags 10 Uhr bis nachmittags 1 Uhr, Dienstags und Donnerstags ausserdem abends von 6–9 Uhr, an den Sonntagen: Nachmittags 1–5 Uhr. Der Besuch ist unentgeltlich.

SANITARY CONTROL OF AN INDUSTRY BY THE INDUSTRY ITSELF.

Lillian D. Wald, head resident nurse, Henry Street Settlement, New York City.

The cloak and suit industry in New York City is one of the most important of the garment-working trades, reported to have an output of $250,000,000 a year and employing from 60,000 to 70,000 people at the height of the season.

The industry is highly organized, the trade-unions controlling some 95 per cent of the employees. The employers in part are organized in the Manufacturers' Protective Association, the members of which are said to control over 60 per cent of the output.

Though the workers have shown great ability in the last two years in holding their organization together, they are much affected by the influx of immigration, probably more so than any other trade, as it is estimated that fully 10,000 immigrants per year are absorbed by this industry; and the leaders of the trade-unions have the enormous task of harmonizing the different nationalities, teaching them the purposes and importance of collective bargaining, and of loyalty to the organization. They suffer also from the lack of permanency even among the leaders. However, there have been satisfactory demonstrations of the ability of immigrants to comprehend their power and the importance of keeping up so-called American standards by adherence to the trades-unions.

The employers also are to some extent in this condition of flux. Contractors and manufacturers with little capital are enabled to open up " factories," many of whom are represented in the 40 per cent outside the membership of the Manufacturers' Protective Association and are in competition with them. The prosperous manufacturers, largely represented in the association mentioned, have moved out of the congested parts of the city, rent or own good lofts, furnish electric light and power, and maintain increasingly high sanitary standards. They suffer from the competition of employers of smaller capital, who to a large extent maintain the least sanitary shops and who, because of this and of their inexpensive plants, are able to manufacture at less cost and have this economic advantage over their more responsible rivals. Being less susceptible to public sentiment, they have it within their power to exploit their employees more readily.

Partly on this account the employers represented in this organization (who, though they control 60 per cent of the output of the industry, are a minority of the manufacturers) were ready to receive favorably the creation of joint responsibility of the organized bodies for decent sanitary conditions and through its power to more nearly equalize conditions of competition, the power of the trades-unions being, of course, exercised over the shops outside of the Manufacturers' Association.

In the summer of 1910 there was a general strike in this trade which lasted nine weeks and drew into the contest sympathetic friends of both sides. The strike finally terminated in the signing of a so-called protocol of peace, according to the terms of which some interesting and hitherto untried agencies for the maintenance of industrial peace and sanitary standards were established. It was significant of the dissatisfaction with insanitary conditions in the shops that among the claims of the strikers was the demand for better regulation of their working places in this regard.

The joint board of sanitary control, established by both parties under the protocol, originated the machinery for inspection and regulation of shops and factories, and later created through the power of both organizations the means of establishing and maintaining standards of sanitation by the trade for the trade.

Before the strike of 1910 the sanitary conditions of this industry had been typical of the garment-working trades, with the exception of the larger and more prosperous establishments in the modern loft buildings to which reference has been made. The congested, insanitary places which would not admit of ventilation, regulation of light, or adequate protection from fire hazards, nor of decent toilet accommodations, were more the rule than the exception. While the sweatshop is practically eliminated in this trade in New York City, the sanitary conditions of the smaller East Side shops were not much better than the sweatshop.

Section 15 of the protocol of peace made mandatory the creation of the joint board under the following terms:

> The parties hereby establish a joint board of sanitary control, to consist of seven members, composed of two nominees of the manufacturers, two nominees of the unions, and three who are to represent the public; the latter to be named by Meyer London, Esq., and Julius Henry Cohen, Esq., and in the event of their inability to agree, by Louis Marshall, Esq.
>
> Said board to establish standards of sanitary conditions to which the manufacturers and the unions shall be committed, and which the manufacturers and the unions obligate themselves to maintain to the best of their ability and to the full extent of their power.

Very soon after the signing of this the organization was effected as ordered, with three representatives of the general public as follows: Dr. William J. Schieffelin, chairman; Dr. Henry Moskowitz, secretary; Miss Lillian D. Wald, treasurer; Dr. George M. Price, chairman of the executive committee, the representative of the trades-unions.

The attorneys for both sides, Meyer London, Esq., and Julius Henry Cohen, Esq., are present at meetings but do not vote.

Enforcement of laws relating to sanitation of buildings, conditions of employment, and so forth, is vested in various State and municipal departments: The State department of labor, the city department of health, the city department of fire—the newly created bureau of fire protection, the city department of buildings.

The efficiency of this enforcement depends upon the integrity of the inspectors, the adequacy of appropriations, and freedom from political interference in appointment and control of the agents, and also upon intelligent public approval of the laws without which even the civil-service-protected inspector can not accomplish much. Pending the attainment of greater perfection in law enforcement, agencies outside the official departments must be established to reenforce them and to maintain that eternal vigilance without which they inevitably deteriorate.

All the members of the joint board of sanitary control serve gratuitously, but employ a clerical and inspectorial staff. The members were fortunate in numbering among them an expert sanitarian, appointed by the trades-unions as their representative; and they started immediately a comprehensive, systematic investigation of all the shops in this industry in the city for the purpose of formulating and establishing standards.

The sum of $1,000 was promptly contributed by each party to the agreement (manufacturers' association and trades-unions) for this preliminary work.

The board, in addition to its membership, had the voluntary aid of some of the foremost sanitary and industrial experts in the country, who gave counsel in the organization of the work, in preparing the schedules, and, later, in making the statistical deductions. A staff of able inspectors was engaged and was specially instructed upon the social significance of their work, and, as a result, entered into it with enthusiasm.

INSPECTIONS.

The first inspection covered 1,243 shops, of which two-thirds were found defective in fire protection or sanitary conditions or both. After the preliminary investigation the more permanent policy of the board was decided upon, and an estimated yearly budget of $7,000 was met without question by the two parties, each contributing equally. In addition to this sum, money fines imposed upon workers or manufacturers for violations of shop rules, or protocol mandates, have been turned over to the treasurer of the joint board, amounting in the last year to something less than $700.

Semiannual inspections of the shops are made. The record of each shop is constantly checked up. Expert methods of administration regarding complaints, recommendations, and orders have been established, and a complete sanitary survey of the trade is constantly on file.

The statistics of the fourth inspection have not yet been completed, but it is safe to say that most of the sanitary defects and fire dangers will be found to have been remedied.

The semiannual inspections and the continuous following up of complaints made either by the unions or the inspectors have enabled the board to improve its enforcing methods. When the routine of administrative machinery has been tried ineffectually, the manufacturer against whose shop complaint has been made is reported to the association, if he is a member, and is disciplined by that organization.

The sincerity of the manufacturers' association has been tested, and its cooperation has proven effective. It has assisted the board in securing structural changes in the shops, involving expense, sometimes serious, on the part of the manufacturer or the owner, in order to comply with the orders of the joint board.

Thirty-eight shops in the association were found to require such alterations. All but two or three have complied, and the counsel of the association will probably succeed within a short time in securing compliance from all.

METHODS OF ENFORCEMENT.

In shops not under the jurisdiction of the manufacturers' association the union is under obligation to enforce the orders of the board. If compliance can not be secured from the employer the union is instructed by the joint board to withdraw the men; and, as a result, during the first year of the board's existence, 27 sanitary strikes, involving 350 people, were called. The average duration of these strikes was a fraction over a week. Obviously, these are heroic measures, and are only taken when all other means for enforcing orders for better sanitation have been exhausted.

The usual action for the employer thus treated has been to move into better quarters that would meet with less condemnation if not with the entire approval of the joint board.

EDUCATION OF WORKERS.

Reliance upon inspection only has not been considered sufficient, and a far-reaching educational campaign, particularly among the workers, has been undertaken. This educational campaign consists of public meetings. The first one, in historic Cooper Union, attracted thousands of workers. The hall, with a capacity of 2,000 people, was crowded, and the audience overflowed to the sidewalks and adjacent streets. The audience was almost entirely composed of cloak and suit workers, eager to hear from the lips of their trusted leaders and friends the gospel of sanitation and the possibility of promoting it.

Lectures in a large public school in the neighborhood where the greater number of the workers live, were given by experts with the cooperation of the department of education. These lectures were upon factory legislation, factory education, factory sanitation, industrial poisons. Talks on the purposes of the board and instruction in elementary hygiene were given in the shops.

Shop sanitary committees were appointed in 336 shops, and more are to follow.

Plain talks have been given to the workers by other workers, who tell them that "the body is nourished by fresh air, cleanliness, and sunlight as well as by food."

Further educational work has taken the form of publication of the joint board's bulletins and reports.

Articles have been printed in the trade papers.

Educational propaganda by the unions goes ceaselessly on through their various agencies.

The following sanitary standards were established by unanimous vote:

SANITARY STANDARDS.

1. No shop to be allowed in a cellar.
2. No shop to be allowed in rear houses or attic floors without special permission of the board.
3. Shops located in buildings two stories or more in height must have one or more fire escapes.
4. All fire escapes to be provided with ladders to the roof of same house or to an adjoining house; also with full-length drop ladders properly located and adjusted.
5. In all shops which are not provided with automatic sprinklers there should be kept a sufficient number of chemical extinguishers, or a sufficient number of fire buckets, properly located and filled.
6. Special caretakers to be appointed in each shop for the care of the fire buckets and for their use in case of fire.
7. All openings and exits to fire escapes to be left unobstructed by tables, machines, boxes, partitions, and iron bars.
8. No doors to be locked during working hours.
9. No smoking to be permitted in workshop.
10. Conspicuous signs to be placed throughout the shop marking location and direction of exits and fire escapes.
11. Fireproof receptacles, lined with tin and having a tin cover, to be provided in sufficient numbers for rubbish.
12. Halls and stairways leading from shops to be adequately lighted by natural or artificial light.
13. Stairs to be provided with secure handrails and safe treads.
14. Sufficient window space to be provided for each shop so that all parts of the shop be well lighted during the hours from 9 a. m. to 4 p. m.
15. Where gas illumination is used arc lights or incandescent mantles should be used.

16. All lights to be well shaded, to be placed above operatives, and not too near them.

17. At least 400 cubic feet of space, exclusive of bulky furniture and materials, should be provided for every person within the shop.

18. The shop should be thoroughly aired before and after work hours and during lunch hour by opening windows and doors.

19. No coal should be used for direct heating of irons, and whenever stoves are used for heating shops they should be surrounded by metal sheet at least 5 feet high.

20. Walls and ceilings of shops and water-closet apartments should be cleaned as often as necessary, and kept clean.

21. Floors of shops and of water-closet apartments to be scrubbed weekly, swept daily, and kept free of refuse.

22. A separate water-closet apartment shall be provided for each sex, with solid partitions to extend from floor to ceiling, and with separate vestibules and doors.

23. Water-closets to be adequately flushed and kept clean.

24. A special caretaker to be designated by the employer to the care of the shop and water-closet apartments.

25. A sufficient number of water-supplied washbasins to be provided in convenient and light locations within the shop.

26. Suitable hangers should be provided for the street clothes of the employees, and separate dressing rooms to be provided wherever women are working.

27. Water-closet apartments, dressing rooms, wash rooms, and lunch rooms to be properly lighted, illuminated, ventilated, cleaned, and kept clean.

28. All seats to have backs.

After the passage of the laws of 1912, recommended by the New York State Factory Investigating Commission, appointed by Gov. Dix, the following new standards were added:

29. All waste materials, cuttings, and rubbish must be removed twice a day from the floor of the shop and once a day from the building.

30. In all shops where more than 25 persons are employed above the ground or first floor a fire drill of the occupants of such building shall be conducted at least once in every three months.

31. In every factory building over seven stories or over 90 feet in height in which wooden flooring or wooden trim is used and more than 200 people are regularly employed above the seventh floor or more than 90 feet above the ground level of such building, the owner of the building shall install an automatic sprinkler system approved as to form and manner in the city of New York by the fire commissioner of such city, and elsewhere by the State fire marshal. Such installation shall be made within one year after this section takes effect.

Sanitary certificates are issued by the joint board and are granted to shops that have complied with all the standards established by it. Up to September 1, 1912, 553 sanitary certificates have been granted, 620 shops containing over 60 per cent of the workers. After the fourth inspection, which is now being made, the number of certificates issued will be increased.

This certificate is good for six months, and is revokable for cause. Unfortunately, the sanitary certificate covers the shop but not the garment. One of the difficult elements is the fact that large manufacturers sometimes employ subcontractors whose shops are below standard. There is lack of control of these garments made even by the large manufacturers.

Recently, upon demand of the joint board, the Manufacturers' Association agreed to compel the contractors employed by their members to put their shops into condition for the certificate, and a large number of these contractors have received them.

INVESTIGATION OF VENTILATION.

The board secured the services of Dr. C. T. Graham Rogers, chief medical inspector of the State bureau of labor, to make an intensive investigation of ventilation and air conditions in the suit and cloak factories. The results of this were published in the first annual report of the joint board.

Dr. Rogers states, as a result of this investigation, that it has been clearly determined that the atmospheric conditions found in a majority of shops are not conducive to good health and should be remedied. He traces much ill health among cloak makers to defective ventilation, to foul air, and to the stooping posture of the workers.

Unfortunately very little definite progress has been made, even by experts on ventilation, to give enlightened employers and labor leaders definite standards of ventilation and methods for securing it.

Investigation of the shops has disclosed little violation of the law providing for 250 cubic feet of space per person. This space is doubtless ridiculously inadequate. Overcrowded shops with very little free available space show upon measurement the necessary 250 cubic feet per person. With ceilings 10 feet high, that space allows but 25 square feet of floor space, and no deduction is made for space occupied by machinery, bulky material, stock, and so on.

Inspection of the shops has not greatly affected the ventilation, beyond the general sanitary conditions, which have been greatly improved. Dirty walls, ceilings, floors, and windows have been cleaned, more adequate provision made for the disposal of garbage, and separation of toilet accommodations for men and women has been secured.

PHYSICAL EXAMINATION OF WORKERS.

Recently the board has undertaken the physical examination of the workers, for the purpose of securing data on occupational diseases. Eight hundred workers volunteered and were examined, showing a high tuberculosis rate, as might have been expected; i. e., 16 to the 1,000. The other diseases are also much higher than the average disease rates of the United States. Further special investigations will doubtless be made.

Morbidity statistics of the 800 cloakmakers examined by the joint board of sanitary control·

	Total.		Operators.		Pressers.		Finishers.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Numbe	Per cent.
No diseases	298	37.3	129	16.1	20	2.5	149	18.6
One or more diseases	502	62.7	262	32.8	60	7.5	180	22.5
Total number examined	800	100.0	391	48.9	80	10.0	329	41.1
Nativity:								
Russian	379	47.4	170	21.3	21	2.6	188	23.5
Italian	186	23.2	105	13.1	3	.4	78	9.7
All others	235	29.4	116	14.5	56	7.0	63	7.9
Total	800	100.0	391	48.9	80	10.0	329	41.1
Number of years in trade:								
Under 1 year	10	1.2	....	....	....	....	10	1.2
1 year to 5 years	253	31.6	64	8.0	25	3.1	164	20.5
6 years to 10 years	190	23.8	98	12.3	20	2.5	72	9.0
11 years to 20 years	214	26.8	145	18.1	26	3.3	43	5.4
21 years and over	133	16.6	84	10.5	9	1.1	40	5.0
Total	800	100.0	391	48.9	80	10.0	329	41.1
Age groups:								
16 to 19	104	13.0	14	1.8	....	....	90	11.2
20 to 24	190	23.8	81	10.1	6	.8	103	12.9
25 to 34	250	31.3	163	20.4	29	3.6	58	7.3
35 to 44	158	19.7	92	11.5	30	3.7	36	4.5
45 and over	98	12.2	41	5.1	15	1.9	42	5.2
Total	800	100.0	391	48.9	80	10.0	329	41.1
DISEASES.								
General:								
Phthisis	13	1.6	9	1.1	....	....	4	.5
Rheumatism	45	5.6	28	3.5	6	.7	11	1.4
Anemia	173	21.7	102	12.8	15	1.9	56	7.0
Total	231	28.9	139	17.4	21	2.6	71	8.9
Nerves and special senses:								
Ear	7	.9	6	.7	....	....	1	.1
Eyes	51	6.4	29	3.6	12	1.5	10	1.2
Nose	35	4.4	23	2.9	6	.8	6	.8
Nerves (not specified)	18	2.2	10	1.3	2	.2	6	.8
Total	111	13.9	68	8.5	20	2.5	23	2.9
Circulatory:								
Heart	36	4.5	22	2.8	5	.6	9	1.1
Arteries	32	4.0	13	1.6	8	1.0	11	1.4
Varicose veins	1	.1	1	.1	....	....	....	....
Total	69	8.6	36	4.5	13	1.6	20	2.5
Respiratory:								
Larynx	7	.9	5	.6	2	.2	....	....
Bronchitis—								
Acute	25	3.1	17	2.1	3	.4	5	.6
Chronic	56	7.0	26	3.3	11	1.4	19	2.4
Asthma	16	2.0	7	.9	4	.5	5	.6
Pleurisy	6	.7	1	.1	1	.1	4	.5
Total	110	13.7	56	7.0	21	2.6	33	4.1
Digestive:								
Pharynx	106	13.2	76	9.5	12	1.5	18	2.2
Stomach	45	5.7	20	2.5	5	.6	20	2.5
Hernia	17	2.1	8	1.0	6	.8	3	.4
Total	168	21.0	104	13.0	23	2.9	41	5.1

Morbidity statistics of the 800 cloakmakers examined by the joint board of sanitary control—Continued.

	Total.		Operators.		Pressers.		Finishers.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Genito-urinary:								
Nephritis	3	.4	3	.4	....	....	....	....
Cystitis	....	....	....	....	....	....	....	....
Pelvic	79	9.9	3	.4	....	....	76	9.5
Total	82	10.3	6	.8	....	....	76	9.5
Skin:								
Contagious	1	.1	1	.1	....	....	....	....
Noncontagious	10	1.3	6	.8	....	....	4	.5
Total	11	1.4	7	.9	....	....	4	.5
Locomotion:								
Bones	1	.1	1	.1	....	....	....	....
Joints—								
Coronal suture	14	1.8	....	....		....	14	1.8
Knee	14	1.7	....	....	....	....	14	1.7
Total	29	3.6	1	.1	....	....	28	3.5
Miscellaneous:								
Syphilis	1	.1	1	.1	....	....	....	....
Gonorrhea	1	.1	1	.1	....	....	....	....
Total	2	.2	2	.2	....	....	....	....
Total diseases	813	....	419	....	98	....	296	....

At the close of the third sanitary inspection it was possible to make the following comparisons, the report of which was published in the bulletin of the board and widely read by members of the unions and by the employers:

> The board then had a sanitary survey of 1,884 shops, compared with 1,738 in the second inspection, and 1,243 in the first.
>
> The number of shops with no drop ladders had been reduced from 236 to 38, or from 13 to 2 per cent.
>
> The doors opening in had been reduced from 97 per cent in the first inspection to 79 per cent in the second inspection, and to 48 per cent in the last.
>
> The increase in the number of dressing rooms is indicated by the reduction from 79 per cent of shops with no dressing rooms in the first inspection to 58 per cent in the second and 34 per cent in the third.
>
> And progress in protecting the worker from eyestrain is shown in the fact that the shops unprotected from glare have been reduced from 83 per cent in the first inspection to 72 per cent in the second and 51 per cent in the third.

The development of the industry into the high-loft buildings has brought about serious problems of fire protection. Fifty-five per cent of all the workers in the trade are employed at the height of the sixth story and above.

In the inspection made in February, 1912, 27,813 employees were working above the sixth floor. Many of the buildings, though of fireproof material, are veritable deathtraps, as was unfortunately demonstrated in the Asch Building, when 143 girls lost their lives.

No fundamental solution of the fire danger is possible without reducing the height of factory buildings. Under these circumstances the board of sanitary control can only record success in insisting upon adequate fire escapes, the installation of drop ladders in their proper places, the posting of fire notices, the encouragement of the organization of fire drills, and the creation of intelligent study by those most concerned, namely, the workers themselves.

The existence of a body of people intelligently concerned in establishing and in maintaining modern factory sanitation is of importance to the entire community. The joint board of sanitary control is a novel experiment in democratic regulation of the conditions of a large industry. Responsibility for the work of the board is not confined to the employers only, nor to the workers, but is shared by both in cooperation with the representatives of the public who are, as consumers, hardly less responsible than the others, and who must reflect the progress of a community. The public can not be indifferent to the condition of the workers, and should share with employers the responsibility for the maintenance of better conditions. Probably some extension of the use of a label will be advised, under the authority of the joint board, indicating to consumers the compliance of the employers and the trades unions with an intelligent demand for decent working conditions.

The Consumers' League was a pioneer in promoting this idea in America. The underlying principle will not be different, if the joint board bestows a label which will be able to give the further security of an assurance of the trades unions' approval of labor and wage. The strength of the enforcement of the standards established by the joint board of sanitary control lies to a great extent in its democracy.

INDUSTRIAL INSURANCE THE BASIS OF INDUSTRIAL HYGIENE.

LEE K. FRANKEL,
Sixth vice president, Metropolitan Life Insurance Co., New York City.

Notwithstanding the remarkable development of life insurance in the United States during the last 50 years, a development even greater than in European countries, comparatively little attention has been given to the insurance of individuals against other risks attending life, particularly those of sickness, accident, invalidity, and old age. On the other hand, along with the growth of life insurance there has been a corresponding growth of insurance against the hazards to which property, merchandise, and material things generally are subject.

The reasons for this are not difficult to seek. Human life has, until quite recently, been held cheap. Property has had its distinct value in all ages. Cattle and live stock have had greater worth than wife and children, unless the latter had a distinct wage-earning capacity. Zola's wonderful description of the peasant whose wife and cow were to be delivered at the same time, and who, having funds for only one doctor, sent for the veterinarian, is typical of the earlier viewpoint. Similarly the decline in the English birth rate, following legislation forbidding child labor, indicates the unwillingness to have children whose earning ability must be deferred until they are fairly mature. There is, of course, another side to this picture, and a dark one at that, namely, the apparent inability on the part of many workmen to earn, through their own effort, sufficient to maintain their families.

Primarily, however, the lack of development of insurance against sickness, accident, or invalidity must be laid to the door of the general belief in the inevitability of death and its progenitors. The fatalism of the East Indian, that "what must be will be," applied to all the incidents of life. Death was a calamity, not necessarily to be dreaded, but one which could not be set aside, and which was to be borne with submission or stoicism. Conflagration, plague, sickness, disaster at sea, were all manifestations of a mysterious Providence whose acts could not be gainsaid or thwarted.

It is easy to realize, with this conception in mind, that the original purpose of insurance was to offset losses. The earnings of the dead father were replaced as far as possible by the interest earnings of the insurance money paid at his death. Insurance money could rebuild the house or mill destroyed by fire, replace the vessel lost at sea, pay the physician, or buy another cow in place of the one struck by the train. Indemnity for losses which, in the last analysis, had a money value, was the underlying concept of insurance. Fundamentally, the purpose of insurance was to cover or reimburse individuals for losses suffered through risks and hazards constantly confronting humankind. The reason for insurance was based on the inevitability of loss due to common hazards and the inability of individuals to bear their losses alone. Only by the distribution of these risks and hazards from the shoulders of the one to the backs of the many could the losses be met without great suffering to the individuals concerned.

The illuminating thought that all risks and hazards of life are not inevitable is of comparatively recent origin. Its earliest development, as might have been anticipated, was in the field of property and chattel insurance. As the realization grew that conflagrations were avoidable, and that many of them were due to carelessness and incompetency, a premium was soon put on devices and installations intended either to minimize the results of fires or to prevent their occurrence. Less stress was eventually laid upon the fire engine than upon sprinkler devices and the proper storage and care of combustible substances. In certain mutual fire insurance associations in the United States, whose members must comply with definite rules and regulations prescribed by the associations, the number of fires per annum and the losses incurred have been materially reduced.

The development of similar preventive measures in the field of insurance against sickness, accident, and invalidity has been much more recent. Insurance against these hazards is not new. In fact, there are indications of insurance schemes to cover these contingencies even in Roman times. The guilds of the Middle Ages included, in their schemes of benefit, insurance protection against sickness, and accident. The Friendly Society movement in England, the Mutualités of France and Belgium, and the Krankenkassen of Germany and Austria, are expressions of similar intent to safeguard the members of these associations against the hazards of life. In all of these, however, the original concept included only indemnity for losses suffered.

The United States, of all countries, has probably been the most backward in developing plans for insurance against sickness and its resultants. The fraternal orders, which originally were comparable with the English friendly societies, have largely departed from their primary purposes and have become life insurance associations, and only incidentally fulfill the mutual benefit function of offering protection to their members in the other hazards of life.

We must look to Germany for the first thorough development of the preventive principle in insurance against sickness, accident, and invalidity. Admitting this, it must at the same time be conceded that the results which have been accomplished are due to the social insurance scheme which has been intensively organized since the early eighties. Beginning with accident insurance, there followed, in short order, insurance against sickness, invalidity, and old age. More recently, the scheme has become even more comprehensive by including a very practical and beneficial form of life insurance, namely, pensions for widows and orphans. It is not unlikely that, from time to time, opportunity to insure will be accorded other strata of the population. In fact, a new law, effective January 1, 1913, extends the principle of compulsory insurance to clerks and others in similar occupations.

Under the German scheme, employers were required to insure their employees against the consequence of industrial accidents and to organize themselves in mutual trade associations similar to the mutual fire associations, so well known in Massachusetts. The employers who, prior to 1880, had been unorganized, and in the keenest competition with one another, were brought together on a basis of common interest in the Berufsgenossenschaften or trade associations. Self-interest soon dictated a policy of self-preservation. It was realized by the manufacturer or mill owner that if the premiums which were charged him by the mutual trade association under the law were higher than he had anticipated from his own experience with his workmen, this was due to a disregard of the essential principles of safety and carefulness on the part of other employers in the same class with him. This naturally led to the promulgation of rules and regulations by the Berufsgenossenschaften requiring members to install sufficient safety devices in their respective industries to minimize the percentage of accidents. Since the societies were empowered to collect higher premiums from those who failed to subscribe and to conform to these rules and regulations, the employer found it to his advantage to use every possible means to safeguard the welfare of his workmen.

Eventually, when certain industrial diseases were classified as coming under the provisions of the accident law, the employer found it of financial benefit to equip his establishment so that such diseases would not occur. We need only mention the elimination of white phosphorus in the manufacture of matches, and the manufacture of paints from oxides other than lead. It was an obvious sequence of such provisions that factories and other industrial establishments should be put in the best possible sanitary condition, particularly in order to avoid the presence of dust, impure air, insufficient lighting, and so forth, since it was recognized that these conditions led to impaired health of workmen. Hours of labor were reduced, not merely because of the demands of the workmen through their trade unions, but because the employer realized that overstrain in industry was a responsible factor in bringing about accident and disease. It can not be said that these and other concessions on the part of the employer were due to any sentimentalism. It was " business," pure and simple. The employer introduced safety devices, put his factory in the best sanitary condition, and developed a factory hygiene, because it paid him to do so; because in time the lack of these means greater inefficiency. more expense, and the inability to compete with his more enlightened competitors. The wonderful industrial development in Germany in the last 25 years can unquestionably be attributed, in large measure, to the social-insurance scheme which prevails there, and which has taught the employer, as well as the employee, the utility of work under conditions which maintain health and prevent useless and avoidable injury and disease.

A development similar to the above has taken place more recently in connection with the sickness-insurance scheme. The reason for this later development is readily seen. The sickness-insurance associations, until within recent years, have been organizations with limited membership, the workmen themselves having the larger representation in the boards of control. It was impossible for sickness societies with several hundred members to institute measures of prevention in the hope of reducing the amount of sickness. It is questionable, in fact, whether in the earlier years these societies, owing to their peculiar structure, realized the possibility within themselves for improving the health of their members. Workmen, even when organized, have as yet not had the financial stimulus for a comprehensive scheme of social engineering.

This has largely been the opportunity of the employer. Nevertheless, even with the disjointed scheme of sickness insurance, which was enacted in the original legislation as a compromise to meet an existing situation, it soon became apparent that the province of the sickness societies was to prevent sickness as well as to pay benefits to their members when incapacitated by disease. To-day, the tendency in Germany is to consolidate a number of small sickness societies into one large society, and thus, by centralization of management, to inaugurate proper preventive measures. In cities like Leipzig, Dresden, Berlin, and others, where such consolidation has already taken place, the sickness societies strain every effort to educate their members in hygiene and sanitation. Many of these societies have sanatoria, convalescent homes, fresh-air homes, Zander institutes, and dental clinics for the use of their members, and by the distribution of literature, and in other ways, the members are educated regarding the prevention and cure of tuberculosis, the results and danger of sexual disease, and the evils of alcoholism.

Even more pronounced are the efforts of the officials who administer the invalidity-insurance scheme. It may in truth be said that the sickness insurance societies have followed in the wake of the invalidity-insurance departments in organizing a social therapy. It can not be too often repeated that in invalidity and sickness insurance, as in accident insurance, sentiment has played but a small part. This is written, not as a reflection upon the insurance scheme, but rather in a spirit of commendation. The invalidity departments throughout the empire have built their chain of hospitals, sanatoria, and so forth, have loaned their millions of marks to erect workmen's dwellings, and are insistent that the invalid workman receive the best possible medical treatment in the early stages of his sickness, because it has been proven by experience that, in the long run, it is more economical to prevent disease or to cure it, than to pay pensions over a period of years to victims of chronic invalidism or permanent disability.

Have the results justified the soundness of the conviction embodied in the German law? This paper is being written, as it were, on the spot, after an intensive study of the things that have been accomplished. More and more is the writer of the opinion that the views which he has expressed in other places as to the soundness of the principles underlying the German insurance scheme are correct. It seems clear, from recently gathered statistics in the invalidity department, particularly that of Berlin, that the number of new invalidity pensioners is annually growing smaller, while the number of old-age pensioners is growing larger; or, in other words, that fewer individuals are permanently incapacitated by illness, while more of them are reaching the seventieth year than heretofore. Notwithstanding the recent diatribe of Friedensburg on the accident-insurance law, it can not be denied that, in proportion to the number of the insured, there has not been a marked increase in the number of accidents, while in the number of injuries producing permanent incapacity there has been a decided diminution.

Practically the same is true in the field of sickness insurance. It does not appear that there has been any increase in the amount of sickness, but rather the contrary. It must be remembered that, to-day, the German workman is fully cognizant of his rights under the law, that no effort is made to bar him from receiving his legitimate benefits, but rather the reverse; in fact, distinct propaganda is made to encourage the insured to avail themselves of the benefits of the insurance at the earliest moment after illness sets in, in the hope that working efficiency may be quickly restored and chronic or continued illness prevented. It must be further remembered that the very rapid development of industry in less than three decades should have had the tendency to increase occupational disease and accidents, particularly since many of the communities in which factories and mills have grown like mushrooms were formerly agricultural in character.

The moral is obvious. It is quite evident that the German insurance legislation has been effective in producing a comprehensive industrial hygiene, which, while still in its infancy, gives assurance of continued improvement and growth. It is equally evident, on the other hand, that drastic general legislation superimposed upon a people or community is honored more in the breach than in the observance, and that attempts to inculcate principles of hygiene and sanitation on a semiphilanthropic basis are repugnant to self-respecting and intelligent workmen. It is not the compulsory principle in the German insurance scheme that has made it effective, but rather the insurance principle itself. It could probably be demonstrated that a voluntary insurance scheme could be made equally effective. Many of the private accident insurance companies have issued instructions to their policyholders for the prevention and minimization of accidents. Stock and mutual fire insurance companies, as stated above, have for years valued sprinkling devices, and steel and stone construction, above fire engines. The large life insurance companies more recently have engaged in a campaign for the extension of human life. Free examination of policyholders is offered; circulars of instruction and information are issued. With particular respect to workingmen, the experiment of the Metropolitan Life Insurance Co., of New York, is proving that it is possible to educate millions of working men, women, and children in the principles of industrial and domestic hygiene. Both the literature on health topics which the company has distributed, and the visiting nurses whom it is sending into the homes of its policyholders, have, as their primary object, the education of policyholders in the fundamentals of good health and right living. The details of this experiment will be found in the special pamphlets which the company has had prepared for this Congress. Incidentally, the cooperation of policyholders has been secured, not through force, or pressure, or compulsion, but voluntarily, in the knowledge, on the part of policyholders, that the experiment is a concrete expression of their concerted views, to which, as individuals, they would be unable to give expression.

In its last analysis, insurance is an intensified form of cooperation. It is the union of masses of men to bear a common burden. Whether this union, in its origin, is compulsory or voluntary, is of secondary importance. The German results show that, even under a compulsory plan, which requires personal contributions from employer and employee, both have a personal interest in any development which affects their immediate welfare. That there is an even greater personal interest in voluntary organizations has been amply demonstrated by the Friendly Society movement, under one name or another, in its manifestations in various countries.

Our need in the United States is the cultivation of the principle of prevention as applied to sickness and invalidity, similar to the beginnings which have been made in insurance against fire and accident. Before this can be done, however, we must have a comprehensive scheme of insurance against the consequences of sickness and invalidity. The development of this form of insurance in the United States is as yet fragmentary and insubstantial. Its further and more complete growth should be a matter of the immediate future.

DISCUSSION.

Dr. I. M. Rubinow, chief statistician of the Ocean Accident & Guarantee Corporation, New York. There are just a few points I should like to call attention to in the interesting paper of Dr. Frankel. The first is the title of the paper, which, I believe, is unfortunate. It has been explained that under this term the author understands the entire sum total of insurance institutions which is coming to be designated in Europe more and more universally as "social insurance," rather than the particular form of life insurance of workingmen by commercial insurance companies which is known in this country under the name of "industrial insurance." It is true there has been an effort by Prof. Henderson, of Chicago, to give the term "industrial insurance" this broader interpretation, but this proposal had had very little support. At this stage of the development of the principles of social insurance, when both the principles and the term itself are rapidly growing in popularity in this country, and since the term "industrial insurance" has the well-defined meaning to perhaps 20,000,000 holders of these industrial policies, and especially in view of the radical differences between the two forms of insurance in form, in organization, and in purpose there is nothing to be gained, and a good deal of accuracy and precision to be lost by this confusion of terms.

However, this may, after all, be considered a minor matter. More important is what is, in my opinion, an overemphasis of the insurance basis of industrial hygiene, especially as applied to private voluntary insurance. It is undoubtedly true that a good many effective measures of hygiene may owe their origin to the desire to reduce the cost of insurance. And it is possible to imagine that an insurance institution may encourage such measures of hygiene with a view of decreasing its losses. Nevertheless, the desire to reduce insurance losses or save on insurance premiums ought never to be the basis of industrial hygiene. Human life is too precious to be measured in terms of profit or loss to an insurance institution. A more fundamental basis of industrial hygiene must therefore be found. It is easy to imagine that if a man who carries a $10,000 life insurance policy is stricken down with an attack of appendicitis, and lacks the necessary funds for treatment, it may pay the insurance company to advance that person $500 for the cost of an operation. But I, for one, would not want to be in a situation where my chance of life and death depended upon the judgment of an insurance company as to its opportunity for profit or loss.

It is true that the same criticism may be offered of other views expressed at the meetings of this section. There has been a marked tendency to have the appeal for industrial hygiene and for accident prevention based upon the ground of increased efficiency or saving of costs to the employer. Of course, there is no objection to soliciting the employer's cooperation on that ground, but surely the true basis of industrial hygiene is the accrued benefit to the employee and not to the employer. The danger lies just here, that as soon as you emphasize the question of cost and savings, you must face the problem of comparative costs, when you reach the point where additional prophylaxis may be bought only at a loss to the employer. Can any scientific theory of industrial hygiene stop at that point, and go no further? The same holds true of the connection between insurance and hygiene. There is a close connection between the two in Germany and other countries, to be sure. But it is mutual cooperation, and not subservience of hygiene to insurance interests. If the German sickness and invalidity insurance institutions do a good deal of prophylactic work, the saving of insurance costs may be an additional argument in its favor, but it is not its basis. Both are equally important expressions of the spirit of social cooperation, and the only true basis is the welfare of the classes concerned.

Finally, I am somewhat inclined to disagree with the assertion that whatever is possible to compulsory insurance is possible also to voluntary insurance. That is a problem which has been quite satisfactorily considered and settled in European theory and practice. Perhaps this statement is a result of the confusion of terms which I have mentioned. There are three essential points which distinguish social insurance from private and voluntary insurance. Private insurance is a legitimate business, conducted for profit like any other business, while the element of profit does not exist in social insurance. Private insurance is conducted inevitably with a high cost of administration, while in social insurance the effort is to reduce this cost to a minimum. And, finally, in private insurance the entire cost must be met by the insured, while all social insurance is based upon recognition that the insured is unable to meet all of this cost, and part of it is shifted upon other shoulders, either upon the employer or upon society at large.

Keeping these distinctions in mind, it is quite evident that neither intensively nor extensively can the results of voluntary insurance approach those of compulsory insurance. And if that be true of insurance itself, it must necessarily be equally true of the prophylactic activity of insurance institutions. As a matter of fact, there is a tendency to too greatly overvalue these prophylactic results. Perhaps in no line of private insurance are these prophylactic measures so much in evidence as in fire insurance. Nevertheless, our fire loss in this country is still enormous and is still increasing.

To sum up, the value of insurance is enormous, quite independently of prophylaxis. On the other hand, there can be no more important basis for industrial hygiene than the health and happiness of the industrial population. It seems to me that its social importance is lowered by over-emphasizing considerations of financial gain or loss, whether to the employer or to the insurance company.

THURSDAY AFTERNOON, SEPTEMBER 26, 1912.

THE HYGIENE OF OCCUPATION AND ITS ADMINISTRATIVE CONTROL.

Dr. WM. C. HANSON, assistant to the Secretary, Massachusetts State Board of Health, Boston.

For the proper study of the effect of occupation on health each State must have an adequate body of field workers, whose work must be intelligently supervised by some competent authority. Prominent among the field workers must necessarily be well-trained physicians. The supervising authority should, in the interest of the entire community, be the central health authority of the State—the State board of health. That such a system is logical and practical has been amply shown by the work of the Massachusetts State Board of Health during the last eight years.

The hygiene of occupation conducted within industrial establishments is an important part, but only a part, of the hygiene of the community. Moreover, with the exception of those occupations which are intrinsically dangerous to health by reason of the nature of the materials involved, intelligent conclusions as to the effect of work conducted in the industrial establishments can not be reached without some knowledge of the home and community life of the worker.

Occupations outside of industrial establishments are in many instances as productive of injury and disease as are those conducted within the walls of a factory. Overcrowded localities, including overcrowded, unventilated, dirty, and insanitary homes, immorality, intemperance, high birth rate, ignorance, and improper and insufficient food furnish all the conditions that favor a high mortality. It is, therefore, not an easy matter to determine correctly the amount of influence properly chargeable to a given occupation.

Such work as the State inspectors of health of Massachusetts have accomplished in the industrial establishments of the Commonwealth emphasizes the need of furthering the study of occupational hygiene throughout the country on such a scientific basis as that now well established by the Massachusetts State Board of Health, and of including in the investigation of the prevalence of communicable diseases and dangerous influences within the factory inquiries concerning the health of adults as well as minors. In this work the position of the State inspectors of health of Massachusetts is unique, so far as America is concerned. These officials are constantly in touch with the prevalence of diseases in their respective health districts, and, further, with practicing physicians whose assistance they frequently get, not only concerning communicable but occupational diseases.

It has thus remained for the State of Massachusetts, the State which established the first State board of health in this country, to lead all other States in the recognition of the fact that the inspection of industrial establishments by well-trained medical men under the supervision of a board whose duty it is to study the health of the community in its broadest sense—the State board of health—means the promotion of public health.

THE PREVENTION OF OCCUPATIONAL DISEASES.

Dr. H. Linenthal, State inspector of health, Boston.

The term "occupational diseases" is not a well-defined one. Broadly speaking, morbid conditions resulting from occupations can be divided into two general groups:

1. Morbid states resulting from certain industrial processes giving rise to specific diseases, such, for instance, as lead, mercury, arsenic, and phosphorous poisoning among workers in industries where these chemicals or their compounds are used. In this group of cases the causal connection between the chemical used and the morbid changes in the body tissues of the worker is clear and unmistakable.

2. Morbid states resulting from insanitary conditions under which workers are employed. Such conditions need not give rise to specific diseases, but may so reduce the resisting power of the individual as to make him fall an easy prey to any contagion with which he may happen to come in contact. The general debility or tuberculosis in a person employed in a sweat shop, for instance, where the sanitary conditions are bad, where for 10 hours or more of the working day he is shut up in an unclean, poorly lighted, badly ventilated room, would be a case in this group. Unlike the first group, the industrial conditions here act as predisposing causes rather than the immediate causes of the disease.

The clear definition as to what constitutes occupational diseases can, however, only come in question in connection with workmen's compensation acts where the workman is entitled to indemnity for diseases arising from his work. From the standpoint of preventive medicine, a clear definition as to what diseases should be called occupational diseases is not essential. Preventive medicine concerns itself equally with the ill effects upon the health of workers, whether these effects result from certain industrial poisons or from certain entirely avoidable insanitary conditions. In fact, from the standpoint of the conservation of the health of the worker, the alleviation of the conditions which do not cause specific diseases, but which have as their inevitable consequence the diminished bodily resistance with greatly increased susceptibility to diseases of all kinds, is of even greater importance than the dealing with the causes of specific industrial diseases. More important, because it affects greater numbers. The number of workers employed in trades recognized as dangerous is but a small fraction of the vast number who are employed in the enormous variety of industries which in themselves are not injurious to health, but which undermine the health of the operatives by the entirely avoidable insanitary conditions under which they work.

Considering the vast importance of the effect of industrial processes and labor conditions upon the health of operatives, the paucity of statistical data on the subject is extremely deplorable. There are a great number of industries in Massachusetts, for instance, in which the workers are exposed to lead and its compounds, yet we have no means of knowing the actual number of cases of lead poisoning that occur annually in the State. The same is true of all the other organic and inorganic poisons that are used, more or less extensively, in our industries. Our knowledge is still less as to the effect on the morbidity and mortality of the industrial community from insanitary conditions, the effects of which are more remote than are those of industrial poisons. There is no available data on the subject.

The causes for our lack of data are obvious. With few recent exceptions physicians are not required to report any cases of occupational diseases to any central health authority, and no knowledge is therefore available as to the number of those cases that occur. Moreover, the death certificates give only the immediate cause of death, with no indication as to the primary cause. A lead worker, for instance, may die from cerebral hemorrhage resulting from the arterioscelerosis of chronic lead poisoning. The cause of death will be given as cerebral hemorrhage. Nothing will appear on the death certificate to indicate the fundamental trouble—chronic lead poisoning. Furthermore, not sufficient attention is given in our morbidity and mortality reports to the occupation of the individual at the time the disease was contracted. The little data which is available is often misleading. A worker in a dust trade may begin to feel the ill effects of the dust-laden air to which he is exposed, and may take up some other form of work. Shortly after, a definite diagnosis of tuberculosis may be made, the occupation on the records being the one he is engaged in at the time the diagnosis is made, one which could not possibly be responsible for the tubercular condition. No mention is made as to his previous occupation where the disease originated. Moreover, not sufficient attention is given in medical schools to the effect of occupation on health. In taking histories of cases, the student is trained to inquire into the life habits of the patient, as to the use of tea, coffee, alcohol, tobacco, and so forth. To be sure, these are all very important, but not nearly so important, particularly among wage earners, as is the nature of the work in which the patient is engaged, and the conditions under which he works. It is true that the student is taught to inquire as to the occupation of the patient, but this is recorded in such a general way as to be of little value either in the diagnosis of the particular case in question or in the collection of data from which inferences might be drawn as to the relation of certain occupations to health.

Such general designation as "laborer," "mill operator," "metal worker," etc., is of no value in indicating the work done; even specific statements—"worker in rubber factory," "shoe factory," and the like—do not mean much, since there are a variety of processes in these industries, some of which are of greater significance from the standpoint of the health of the employees than others.

While, of course, it can not be expected that the physician should be acquainted with the infinite complexity of industrial processes, it seems that it would be of great value for him to have a general knowledge of the so-called dangerous trades, and of the particular dangers to the health of the operatives that lurk in some of the processes. The comparatively small amount of time that would be required on the part of the medical student, say, in his fourth year, to acquire this knowledge, would be fully compensated by his greater efficiency in handling his cases in hospital clinics or in private practice.

While it is generally recognized that certain industrial processes are injurious to health and that insanitary conditions in workshops and factories are prejudicial to the well-being of operatives, very little has been done to make systematic investigations into industrial conditions. To the Massachusetts legislatures of 1904–1906 belongs the credit of having taken the first step in this country to obtain definite scientific data on the subject by their authorizing the State Board of Health to make an investigation into the sanitary conditions of factories, workshops, and mercantile establishments. This work was carried on under the able direction of the late Dr. Charles Harrington, and his report to the legislature of 1907 is the first document in this country to deal in a systematic manner with the effects upon the health of operatives in the various industries in Massachusetts.

Following the report of Dr. Harrington, the legislature of 1907 enacted a law whereby the State was divided into health districts, and a physician was appointed in each district as State inspector of health. The original number of districts was 15, but it has since been changed to 14. Under the law, each State inspector of health is required to inform himself respecting the sanitary condition of his district and concerning all influences dangerous to public health or threatening to affect the same; he is to gather all information possible concerning the prevalence of tuberculosis and other diseases dangerous to the public health within his district; he shall disseminate knowledge as to the best methods of preventing the spread of such diseases, and shall take such steps as, after consultation with the State board of health and the local health authorities, shall be deemed advisable for their eradication; he shall inform himself concerning the health of all minors employed in factories within his district, and whenever he may deem it advisable or necessary he shall call the ill health or physical unfitness of any minor to the attention of his or her parents or employers and of the State Board of Health.

Besides these general duties and advisory powers to the local boards of health the State inspectors of health were given the enforcement of all laws relating to the health of persons employed in industrial establishments. Massachusetts was thus the first State in the Union to recognize that factory inspection is essentially a matter of public health and should be under the charge of the central health authority of the State.

Perhaps one reason for the scarcity of our knowledge of industrial conditions and of their effects upon health is that all industrial inspection is, as a rule, done by persons entirely unfamiliar with sanitary matters. Such inspection must necessarily become a mere matter of routine carried on in a perfunctory manner and little calculated to bring about effective changes or to increase our knowledge of the effects of industry on health. To quote Dr. William C. Hanson, assistant to the secretary of the State Board of Health, who is directing the work of the State inspectors of health:

> Medical men alone are in a position to make the best use of facts obtained concerning the sanitary conditions of the premises where men and women work; to study the possible injurious effects of certain processes upon the health of the person engaged therein; to inspect devices designed to protect the employees against injurious and dangerous substances, as well as to detect pathological signs or symptoms of certain poisons and dust and fumes incident to some occupations; to inquire as to the health of the employees; to make physical examination of minors and, whenever possible, of adults engaged in trades deemed to be injurious to health; and to collect and make proper use of all facts and data, including morbidity and mortality statistics pertaining to occupational hygiene.

The work of the State inspectors of health of Massachusetts for the last five years under the direction of Dr. Hanson has already resulted in the accumulation of a vast amount of material on industrial hygiene and on factory sanitation. Thoroughly taken up with his work Dr. Hanson has succeeded in imparting his enthusiasm in this comparatively new field of preventive medicine to the men whose work he directs. Not only have vast changes been brought about in the industrial establishments of the State, but extensive investigations have been made of a great variety of industries and processes in which workers are exposed to influences dangerous to health. Special investigations have thus been made of a number of trades in which workers are exposed to dusts, to irritating and poisonous fumes, to extreme degrees of temperature and humidity, and to general unsanitary working conditions. The industries thus studied include the textile industry, the pearl industry, felt-hat industry, mattress and curled-hair industry, the boot and shoe industry, the rubber industry, the making of jewelry, metal polishing and buffing, a group of industries in which workers are exposed to lead poisoning—such as printing, stereotyping, monotyping and linotyping, electrotyping, paint manufacturing, potteries and manufacturing of tile—foundries, laundries, cigar factories, candy factories, and the clothing industry.

A vast amount of valuable data on industrial hygiene has thus been accumulated by the State inspectors of health and our knowledge of industrial processes and conditions is increasing. This is the first essential step in prevention. We must learn where the danger lurks before we can take any steps to check its ill effects. But there are other measures which would be effective in reducing the baneful effects of many of our present industrial conditions, some of which, although eminently practical, we have not yet put in operation. The following may be indicated among the preventive measures:

Occupational diseases, as many of them as practicable, should be put on the list of reportable diseases. The central health authority would thus quickly learn of any case that might occur. The establishment in which such a case occurred would be visited, and proper steps could be taken to prevent the occurrence of other cases.

The employees in certain occupations in which they are exposed to poisonous dusts and fumes should be examined periodically, so that symptoms of poisoning may be early detected. Young persons who, on account of their age, are more susceptible to dangerous influences should be excluded from certain occupations. Women likewise should be excluded from certain trades. Massachusetts is thus far the only State in the Union to prohibit the employment of minors in trades and processes designated by the State Board of Health as injurious to health. This legislation, of inestimable value in protecting the health of young persons, was the direct result of the observations of the State inspectors of health and of their reports thereon to the State Board of Health.

During the last year, for instance, 143 minors were found engaged in processes which had been declared by the Massachusetts State Board of Health to be injurious to health. They were exposed to lead and plumbago dusts in printing and electrotyping establishments, to pearl-shell dust, to talc dust in rubber works, to the fumes of naphtha in the shoe industry, and to the fumes of dipping metals in acid solutions. In every instance immediate steps were taken to safeguard the health of the minors thus exposed. They were either excluded from the factory, transferred to another department, or, what was most frequently the case, the employer adopted special means and devices which appeared to the State inspector of health to be efficient in protecting the minors against the dangerous influences.

Adequate legislation regulating sanitary conditions in industrial establishments, prescribing protective appliances for those exposed to dust, to irritating gases and fumes, and to industrial poisons, and the intelligent enforcement of these laws, are of course indispensable in order to maintain conditions compatible with safety to the health of the workers.

But of still greater fundamental importance than any of the abovementioned measures is the education of both employers and employees. This becomes evident when numbers of industrial establishments are visited. A few examples will suffice:

In many metal-polishing establishments, where the workers are exposed to metallic and emery dusts, and also to cotton dusts from the buffing wheels, employers maintained that dust-removal systems are unnecessary; that the dust "is not injurious to health." On the other hand, the employees themselves often showed lack of appreciation of the dangers to which they were exposed and frequently removed the hoods from properly guarded machines on the pretext that these interfered with the work.

In visiting rubber factories the foremen, managers, and superintendents were questioned as to the occurrence of cases of lead poisoning among their workers. No record of cases was obtained. Most of them were unaware that there was any danger of lead poisoning and did not know that such cases ever occurred among rubber workers. And yet cases of lead poisoning are not uncommon in that industry. Of a series of 162 cases of lead poisoning treated in the out-patient department in one of our large hospitals over 11 per cent were among rubber workers and undoubtedly came from the same factories that were investigated. This discrepancy between the hospital records and the information obtained at the factories can be explained by the fact that the working population in rubber factories is shifting. Many workers are taken sick and drop out without anyone in the factory knowing anything about them. Inasmuch as a great proportion of the rubber workers are foreigners—Poles, Italians, and so on—the patients themselves may not understand fully the nature of the trouble for which they are treated.

In several color-grinding establishments where lead salts were used no precautions were taken by any of the workers against the lead dust. In one establishment respirators were provided for the men who were exposed to the dusts, but these were not used. In another a man was observed using white lead in the mixing of paint. An open box of the powder was near him, from which he took a scoopful from time to time and threw it into the mixer, where it formed a paste with linseed oil. When all the powder was out of the box he turned it upside down and struck it over the mixer, producing a cloud of fine lead dust which enveloped him. The man stated that he took no precautions of any sort, and that while he had been at this work for 20 years he had been sick only once, suffering, as the doctors told him, from lead poisoning. While talking he took out a plug of tobacco from his pocket and carried it to his mouth, his hands being covered with lead. He was pale and emaciated, and, although only 45 years of age, he had marked arteriosclerosis.

One of the most dangerous processes observed was the sand blasting of iron castings. This consists of playing a stream of fine, dry sand by means of compressed air upon the casting to smooth the surface. During this operation, the worker is completely enveloped by clouds of fine, dry sand. It was stated that the length of time a man can keep at this work is not more than about a year, when he begins to show the effects of it and has to leave, only to be replaced by a new recruit. In one foundry visited, a special helmet, with a tube whereby the worker is supplied with fresh air, was provided for this work, but the man engaged in the process did not use it, "as it was too much bother to put it on and take it off."

Intelligent cooperation with the health authorities, on the part of the employers and employees, is absolutely essential. The employer must learn to realize that the provision of good sanitary conditions is an asset and increases the efficiency of his workers. He should therefore comply with the spirit as well as with the letter of the law, and, by a strict workroom discipline, see that the workers properly use protective devices. The workman, on the other hand, should not only recognize the dangers to health to which he is exposed at his work, but must learn to utilize to the fullest extent the measures which the law requires for his protection.

The central health authority of the community should be authorized to draw up special regulations for industries in which workers are exposed to poisonous dusts or fumes, with instructions, applicable in each particular industry, as to the measures necessary to avoid poisoning. Such regulations and instructions should be posted in the workrooms where the particular processes in question are carried on.

To summarize briefly: For the prevention of the ill effects upon health from industrial processes or conditions, the following measures should be adopted:

1. To collect complete and accurate data about industrial processes and about conditions under which the various industries are carried on.
2. To obtain more accurate and detailed information relative to occupation on morbidity and mortality records.
3. To instruct the medical student in this important field of preventive medicine by a course of lectures on the more important industrial processes and the diseases to which they give rise.
4. To place the specific industrial diseases on the list of diseases notifiable to the central health authority.
5. To examine periodically all workers in certain industries. These industries should be named by the central health authority.
6. To exclude minors and women from certain industries which are designated by the central health authority as injurious to health.
7. To have adequate laws regulating sanitary conditions and protective devices in industrial establishments, and to have such laws intelligently enforced.
8. To have the central health authority issue regulations for certain dangerous trades, with instructions to employers and employees, showing them how they may guard themselves against the ill effects of their work, and to have such instructions posted in the workrooms.
9. To carry on an extensive educational campaign, both among employers and employees, as to the value of protective measures and good sanitary conditions.

UEBER JAPANISCHES FABRIKGESETZ.

Medicinalrat Dr. med. Tadahiro Noda, Tokyo, Japan.

Verschiedene Industrien in Japan haben eine sehr schnelle Entwickelung durchgemacht. Die Anzahl der Werkstätten mit über 5 Arbeitern betrug bei der Zählung am Ende des letzten Jahrhunderts kaum 20,000 die der Arbeiter 450,000 während im Jahre 1909 bereits 32,228 Werkstätten und 800,637 Arbeiter gezählt wurden.

Was die Geschlechter anbetrifft, so ist das Verhältniss zwischen den männlichen und den weiblichen Arbeitern gerade umgekehrt im Vergleich mit anderen civilisierten Ländern; es beruht dies auf der jüngeren Entwickelung der auf männliche Arbeitskräfte angewiesenen Industrien, indem zur Zeit auf Arbeiterinnen ca. 62 Prozent und auf Arbeiter ca. 38 Prozent der Fabrikangestellten gerechnet werden;

daraus kann geschlossen werden, dass das neue Gesetz wenigstens von der hygienischen Seite im Interesse der in physischer Beziehung den männlichen Angestellten nachstehenden Arbeiterinnen ausgearbeitet worden ist.

Da aber früher eine schöne, vom Altertum ererbte Sitte überall bei uns herrschte, nach welcher die Beziehungen zwischen den Unternehmern und den Arbeitern sehr innige, geradezu familiäre waren, d. h., die Unternehmer ihre Arbeiter liebten, ihnen nicht zu starke Anstrengungen zumuteten, und wiederum die Angestellten auch gehorsam und vergnügt arbeiteten, so konnten merkbare Gesundheitsschädigungen der Arbeiter nicht nachgewiesen werden. Erst seitdem sich die grösseren Industrien rasch vermehrt haben, und wie z. B. in der Textilindustrie in einer Werkstatt mehrere Hunderte oder sogar mehrere Tausende von Menschen arbeiten, wobei in der Einrichtung der Fabrikanlagen hauptsächlich auf die Erzielung eines möglichst hohen Gewinnes Rücksicht genommen wurde, sind die gesundheitsschädlichen Verhältnisse in jenen Betrieben ans Licht gekommen; laut der vorgenannten Statistik sind in einem Jahre durchschnittlich angemeldet worden: (1) Erkrankungsfälle bei Arbeitern, 857 Promille, und Erkrankungsfälle bei Arbeiterinnen, 1,080 Promille; (2) Unfälle bei Arbeitern, 118 Promille, und Unfälle bei Arbeiterinnen, 40 Promille. Hierzu habe ich besonders zu bemerken, dass unter den Erkrankungen und Verletzungen alle diejenige Fälle zu verstehen sind, welche ärztliche Behandlungen bedürfen, auch wenn die Betreffenden nicht arbeitsunfähig geworden sind: (3) Todesfälle bei Arbeitern, 3.5 Promille, und Todesfälle bei Arbeiterinnen, 5.7 Promille; und (4) weil von ihrer Erkrankung nicht genesen, mussten von Arbeitern, 1.6 Promille, und von Arbeiterinnen, 17.9 Promille, entlassen werden.

Die Erkrankungen der fürsorgebedürftigen Arbeiterinnen sind meistenteils solche der Ernährungs- und Respirationsorgane, des Nervensystems u. dgl., weil der grösste Teil der Arbeiterinnen ca. 82 Prozent in der Textilindustrie und zwar in Baumwollspinnereien, Seidenspinnereien und Webereien arbeiten. Nach den Anmeldungen der Werkstätten sind in diesen Erkrankungen sehr wenige Tuberkulosefälle inbegriffen, so z. B. 1.0–3.6 Prozent in Baumwollspinnereien, 0.7 Prozent in Seidenspinnereien und 0.1 Prozent in Webereien; die Sterblichkeitsstatistik des Kaiserlichen statistischen Amtes jedoch weist deren ziemlich viele, nämlich über 30 Prozent der Todesfälle bei Textilarbeiterinnen auf. Unsere vielseitigen Untersuchungen haben ausserdem dargetan, dass unter den von den Werkstätten in ihre Heimat Entlassenen auch verhältnismässig viele tuberculös oder tuberculösverdächtig erkrankt oder gestorben sind, so beträgt nämlich die Zahl der Erkrankungen und Todesfälle unter allen aus verschiedenen Ursachen nach der Heimat zurückkehrenden Arbeiterinnen zusammen ca. 28 Prozent, unter welchen die tuberculösen und tuberculösverdächtigen 37.2 Prozent ausmachen.

Ueber die Entlassung der Arbeiterinnen habe ich hier ein paar Worte hinzuzufügen, weil die Zustände vielleicht etwas anders als in anderen Ländern sind; man stellt besonders in manchen Textilindustrien meist Bauermädchen von verschiedenen Bezirken als Arbeiterinnen unter gewissen Vertragsbedingungen an, nimmt sie in bestimmte Wohnungen auf und beschäftigt sie dann zu anstrengend; deshalb fordern die Arbeiterinnen bei irgend einer Gelegenheit die Entlassung, was für die Economie der Betriebe sehr nachteilig ist, da man stets viele kränkliche, schwache Arbeiterinnen, oder aber neu aufgenommene unerfahrene beschäftigen muss.

Aus solchen hygienischen und socialen Gründen ist erst im vergangenen Jahre ein neues Fabrikgesetz erlassen worden, welches durch eine Kaiserliche Verordnung bald in Kraft treten wird, während die Werkstätten bis jetzt nur in Bezug auf Schutzmassnahmen bei Dampfmaschinen und anderen Motoren revidiert und zugleich auch durch Bezirkserlasse in hygienischer, sittlicher, etc., Beziehung beaufsichtight werden.

Das Gesetz lautet wie folgt:

FABRIKGESETZ VOM 28. MÄRZ 1911.

§ I. Dieses Gesetz findet auf die nachstehend genannten Werkstätten Anwendung: (1) Solche, die im allgemeinen mehr als 15 Arbeiter beschäftigen; (2) solche, deren Betrieb gefährlich oder gesundheitsschädlich ist.

Durch Kaiserliche Verordnung können nötigenfalls Betriebe von diesem Gesetz ausgenommen werden.

§ II. Der Unternehmer darf Personen unter 12 Jahren nicht beschäftigen mit Ausnahme derjenigen über 10 Jahre alten Personen, die bei Inkrafttreten dieses Gesetzes bereits in Arbeit stehen.

Zu leichteren Beschäftigungen kann unter Bedingungen, die sich aus der Arbeit ergeben, die Verwendung über 10 Jahre alten Personen durch die Verwaltungsbehörde gestattet werden.

§ III. Der Unternehmer darf Personen unter 15 Jahren und Frauen nicht länger als 12 Stunden täglich zur Arbeit verwenden.

Während 15 Jahren nach Inkrafttreten dieses Gesetzes kann der zuständige Minister je nach der Art des Betriebs die im vorstehenden Paragraphe festgesetzte Arbeitszeit bis zu 2 Stunden verlängern.

Die Arbeitszeit ist, auch wenn die Arbeitsstätte wechselt, den in den beiden vorstehenden Absätzen enthaltenen Bestimmungen entsprechend zu berechnen.

§ IV. Der Unternehmer darf Personen unter 15 Jahren und Frauen in der Zeit zwischen 10 Uhr abends und 4 Uhr morgens nicht beschäftigen.

§ V. In den folgenden Fällen findet die im vorstehenden Paragraphe getroffene Bestimmung keine Anwendung: (1) Wenn die Arbeit aus besonderen Gründen ununterbrochen durchgeführt werden muss; (2) wenn besondere Gründe für Nachtarbeit vorliegen; (3) wenn im Falle, dass Tag und Nacht ununterbrochene Arbeit notwendig ist, die Arbeiter in zwei oder mehr Schichten geteilt und abwechselnd verwendet werden.

Doch dürfen, wenn nach Inkrafttreten dieses Gesetzes 15 Jahre verflossen sind, Personen unter 14 Jahren und Frauen unter 20 Jahren in der Zeit zwischen 10 Uhr abends und 4 Uhr morgens nicht mehr beschäftigt werden.

Der zuständige Minister bestimmt, welche Arbeitsarten zu den im vorstehenden Absatz genannten Fällen zu rechnen sind.

§ VI. Falls die Arbeiter in zwei oder mehr Schichten geteilt und abwechselnd beschäftigt werden, finden die Bestimmungen des § 4 während 15 Jahren nach Inkrafttreten dieses Gesetzes keine Anwendung.

§ VII. Der Unternehmer muss den Personen unter 15 Jahren und Frauen jeden Monat wenigstens 2 Ruhetage gewähren; und falls die Arbeiter in zwei Schichten geteilt sind und abwechselnd in der Zeit zwischen 10 Uhr abends und 4 Uhr morgens arbeiten, oder im Falle des § 5, Absatz 1, No. 2, wenigstens 4 Tage; auch muss er falls die tägliche Arbeitszeit über 8 Stunden beträgt, wenigstens 30 Minuten, und falls sie über 10 Stunden beträgt, wenigstens eine Stunde Ruhezeit gewähren. Diese Ruhezeit ist in die Arbeitszeit einzurechnen.

Wenn die Arbeiter in zwei oder mehr Schichten geteilt sind und abwechselnd in der Zeit zwischen 10 Uhr abends und 4 Uhr morgens arbeiten, muss die Reihenfolge der Arbeitszeit mindestens alle 10 Tage gewechselt werden.

§ VIII. Im Falle von unabwendbaren Naturereignissen und grossen Veränderungen kann der zuständige Minister für bestimmte Bezirke und bestimmte Arbeitsarten nötingenfalls die Paragraphe 3–5 und die Bestimmungen des vorstehenden Paragraphes ausser Kraft setzen.

Aus unabweisbaren Gründen kann der Unternehmer in unerwarteten notwendigen Fällen, nachdem er die Erlaubniss der Verwaltungsbehörde eingeholt hat, für eine bestimmte Frist ohne Rücksich auf die Bestimmungen der Paragraphen 4 und 5 die Angestellten arbeiten lassen und die im vorstehenden Paragraphe genannten Ruhetage aufheben.

In unvorhergesehenen notwendigen Fällen kann der Unternehmer, nachdem er zuvor jedesmal der Verwaltungsbehörde davon Anmeldung gemacht hat, die Arbeitszeit während 7 Tagen im Monate bis zu höchstens 2 Stunden täglich verlängern.

Je nach der Jahreszeit und im Falle dringender Arbeit darf der Unternehmer für eine bestimmte Frist, nachdem er zuvor die Erlaubniss der Verwaltungsbehörde eingeholt hat, während höchstens 120 Tagen im Jahre die Arbeitszeit um höchstens eine Stunde verlängern. In diesem Falle findet für die zugestandene Frist die Bestimmung des vorstehenden Absatzes keine Anwendung.

§ IX. Der Unternehmer darf Personen unter 15 Jahren und Frauen nicht zu den folgenden gefährlichen Arbeiten heranziehen: Zur Reinigung, Einölung, Untersuchung und Ausbesserung gefährlicher Teile an Kraft- und Arbeitsmaschinen, die in Bewegung sind, zum Auflegen und Abnehmen von Riemen und Tauen an Kraft- und Arbeitsmaschinen, die in Bewegung sind.

§ X. Der Unternehmer darf Personen unter 15 Jahren nicht in Betrieben verwenden, wo mit Giften, Halbgiften oder anderen gefährlichen Chemikalien, mit Explosirstoffen, Feuerwerkkörpern oder feuergefährlichen Materialien gearbeitet wird, auch nicht an Plätzen, wo Pulver und Staub sich stark entwickeln, wo schädliche Gase ausströmen, oder solche die sonst gefährlich und ungesund sind.

§ XI. Der zuständige Minister verordnet, welche Arbeiten von den zwei vorstehenden Paragraphen betroffen werden.

Der zuständige Minister verordnet, in wie weit die Bestimmungen des vorstehenden Paragraphen auf Frauen über 15 Jahren Anwendung finden.

§ XII. Der zuständige Minister kann die Arbeit von Kranken oder Wöchnerinnen beschränken oder gänzlich untersagen.

§ XIII. Die Verwaltungsbehörde kann, wenn sie erkannt hat, dass die Werkstätte oder die damit zusammenhängenden Gebäude oder Einrichtungen gefährlich, gesundheitsschädlich oder unsittlich sind, oder dem öffentlichen Interesse zuwiderlaufen, dem Unternehmer die zur Verhütung von Schaden oder Beseitigung von Uebelständen erforderlichen Massnahmen anbefehlen oder dem Unternehmer nötigenfalls die Benutzung der ganzen Anlage oder eines Teiles derselben untersagen.

§ XIV. Der betreffende Beamte darf die Werkstätte und die damit zusammenhängenden Gebäude besichtigen, muss aber eine diesbezügliche Ausweiskarte bei sich tragen.

XV. Wenn der Arbeiter ohne eigenes grosses Verschulden bei der Arbeit verletzt worden, erkrankt oder gestorben ist, so muss der Unternehmer dem Arbeiter oder seiner Familie nach Massgabe Kaiserlicher Verordnung Unterstützung gewähren.

§§ XVI–XXV enthalten andere Verwaltungs- und Strafbestimmungen.

Näheres über Ausführung dieses Gesetzes wird durch Ministerialverordnung bestimmt werden; ich werde hier nur kurze Erklärungen zu einzelnen Paragraphen zufügen:

Zu § I: Im allgemeinen sind diejenigen Werkstätten, die weniger als 5 Arbeiter beschäftigen, Hausindustrien, bei welchen meistens die vorerwähnte schöne ererbte Sitte herrscht, nach der Arbeiter und Arbeitgeber in familiärem Verhältnis leben, und wo das Gesetz deshalb keine Anwendung zu finden braucht; aber wenn die Arbeiter in Betrieben, wo mit Giften, Explosivstoffen etc., oder unter starker Entwickelung von Pulver und Staub gearbeitet wird, beschäftigt werden, so wird das Gesetz nach Absatz 1, No. 2, angewandt. Die Ausnahmebestimmung, Absatz 2, meint überhaupt nicht gefährliche und nicht gesundheitsschädliche Handwerkstätten, wo vielleicht weniger als 20 oder 25 Arbeiter angestellt sind.

Zu § 2: Als untere Grenze des Arbeiteralters sind 12 Jahre ziemlich wenig, aber bei uns vollenden die Kinder in diesem Lebensjahre meistens ihre Schulpflicht. Diese schulentlassenen Kinder armer Leute müssen in den Werkstätten als Hilfsarbeiter ihre leichte Arbeit finden können; und da die Anzahl von 10–12 Jahre alten Arbeitern, welche bereits in Arbeit stehen, nur 0.79 Prozent gerechnet wird, so dürfen diese noch 2 Jahre nach Inkrafttreten des Gesetzes in ihrer Stellung belassen werden.

Absatz 2 ist die Bestimmung, bei welcher die 10–12 Jährigen nur unter gewissen Bedingungen wie z. B. bei ganz leichter, nicht gesundheitsschädlicher Arbeit täglich nicht über 6 Stunden und mit vollgesunder körperlicher Entwickelung beschäftigt werden dürfen. Was die Schulpflicht anbetrifft, so wird die betreffende Kaiserliche Verordnung nicht durch dieses Gesetz umgestossen; die Kinder sind natürlich schulpflichtig, indem sie zugleich die Armenschule besuchen oder in den Werkstätten gehörig unterrichtet werden.

Zu § 3: Bei fast allen Werkstätten mit anstrengender Arbeit beschäftigen die Unternehmer über 17 oder 18 Jahre alte Arbeiter täglich nicht über 8–10 Stunden, aber bei Textilindustrie jüngere Arbeiterinnen manchmal 14 oder 15 Stunden täglich, was durch diese Bestimmung bis zur Minimalgränze herabgezogen werden muss.

Die Ausnahmbestimmung, Absatz 2, meint solche Betriebe, die überhaupt wenig anstrengend und in der Regel nicht das ganze Jahr hindurch fabricieren.

Zu §§ 4 und 5: Für Jugendliche und Frauen wird die Nachtarbeit principiell verboten; aber in besonderen Fällen muss man Ausnahmen machen, z. B. bei Einkochen und Conservieren von leicht in Fäulniss übergehenden Fisch- und Muschelarten, welche manchmal auf einmal verarbeitet werden müssen, oder in Druckereien der Morgenzeitungen, oder bei Glas- und Porcellanfabriken mit ununterbrochenen Feuerung etc., denn nach dem Uebergangsstadium dürfen Männer über 14 Jahre und Frauen über 20 Jahre damit beschäftigt werden.

Zu § 6: Gegenwärtig werden nur in Baumwollspinnereien die Arbeiterinnen in 2 Schichten geteilt und meist alle 8 Tage mit einem Ruhetage abwechselnd zur Tages- und Nachtarbeit verwendet; diese Nachtarbeit verursacht den Arbeiterinnen so grosse Beschwerden, dass sie ihre baldige Entlassung von den Werkstätten nachsuchen, da Körpergewichtsabnahme oder Ernährungsstörung etc., eintritt, deshalb muss man vom hygienischen Standpunkt vor allem diese Nachtarbeit aufheben; aber andererseits vom ekonomischen Standpunkt aus betrachtet könnte man die Nachtarbeit nicht ohne grossen Schaden wegfallen lassen, es sei denn, dass man den Betrieb um das Doppelte erweiterte, um bei nur Tagesarbeit die gleiche Produktion zu erzielen. Man ist genötigt 15 Jahre zu warten, ehe sich der principielle Zustand herstellen lassen wird.

Zu § 7: Bei uns herrscht seit altersher die Sitte, den Arbeitern in der Regel am 1. und 16. Tage im Monat und bei neu entwickelten Werkstätten meist an jedem Sonntag Ruhe zu gewähren. Doch giebt es auch solche Stätten, in welchen die Unternehmer den Angestellten keinen Ruhetag und keine Arbeitspause gewähren und wo die Arbeiter des grösseren Verdienstes wegen sie auch nicht wünschen, deshalb wird hier die Minimalgrenze bestimmt.

Zu § 8: Die Ausnahmebestimmung, Absatz 1, ist im Falle von unabwendbaren Naturereignissen etc., selbverständlich, um die Ordnung herzustellen. Ueber die Bestimmungen, Absätze 2, 3 und 4, muss die Behörde immer vorsichtig ihre Erlaubniss beschränken und streng beurteilen, ob es unbedingt notwendig ist.

Zu §§ 9, 10 und 11. Für die unerfahrenen Jugendlichen und nicht genug ausgebildeten Frauen sind die in den Bestimmungen genannten Beschäftigungen gefährlich und gesundheitsschädlich, bei welchen durch kleine Fehler grosse Gefahren verursacht werden können.

Zu § 12: Den Kranken, deren Erkrankungen sich durch ihre Beschäftigung verschlimmern könnten oder die durch Ansteckungsmöglichkeit ihre Umgebung gefährden würden, ist bis zur Genesung und den Wöchnerinnen wenigstens 4 Wochen lang nach der Entbindung die Arbeit verboten.

Zu § 13: Diese Bestimmung soll Anwendung finden, um voraussichtlichen Schaden zu verhüten oder schon entstandene Uebelstände zu beseitigen; aber nach unserer Ansicht sind die hygienischen Einrichtungen die Hauptsache für das Arbeiterwohl, wir müssen deshalb immer bestrebt sein, nicht nur kraft des Gesetzes Verbesserungen zu fordern, sondern die Unternehmer darin zu unterstützen, allmählig recht hygienische Vorkehrungen zu treffen.

Zu § 14: Um die Ausführung des Gesetzes zu revidieren, müssen die entsprechenden Inspectoren angestellt werden.

Zu § 15: Gegenwärtig werden in manchen Werkstätten die Arbeiter, wenn sie infolge der Arbeit verletzt oder erkrankt sind, umsonst in Hospitälern der Werkstätten oder bei den angestellten Aerzten behandelt, wenn sie gestorben sind, ihren Familien gewisse Unterstützungen gewährt; bei sonstigen Fällen werden die Angestellten sehr billig behandelt oder gewissermassen unterstützt; indem man in manchen Werkstätten Betriebskassen einrichtet. Aber gegenwärtig geschieht es ganz freiwillig, erst durch diese Bestimmung wird die Unterstützung obligatorisch.

Wie ich oben geschildert habe, trifft unser neues Gesetz nur minimale Fürsorge für jugendliche Arbeiter und Arbeiterinnen; es muss daher unser Bestreben sein, im gegenwärtigen Uebergangsstadium die japanischen Industrien darauf zu bringen, dass wir ausser Anwendung des Gesetzes vor allem manche unverständige Unternehmer zur Einführung notwendiger Verbesserungen bewegen und innige Beziehungen zwischen Hygiene und Ekonomie der Industrien herstellen, um allmählige Vervollständigung der gewerbhygienischen Einrichtungen zu erwarten.

THE RELATION OF THE UNITED STATES BUREAU OF LABOR TO INDUSTRIAL HYGIENE.

Charles H. Verrill, of the United States Bureau of Labor.

Unlike the State factory-inspection departments and the State boards of health, the Federal Bureau of Labor is not charged with the duty of enforcing laws or formulating regulations. Its functions are limited to the work of investigation and study and the diffusion of information, but with these limitations—that the duty is imposed on the Bureau of studying the means of promoting the material, social, intellectual, and moral prosperity of the working men and women. It is quite within its scope, therefore, to study the subject of accidents with a view to the elimination, so far as possible, of dangerous machinery and dangerous working conditions, and the introduction of protective devices, or to study factory processes and conditions with a view to eliminating, restricting, or safeguarding the use of poisonous and injurious materials, or to study lighting, ventilation, humidity, the disposal of dust or fumes, and the improvement of the hygienic condition of the working places.

The work of the Bureau has, of course, been limited by the means and force at its disposal. Beginning first with its report on industrial depressions, in 1886, its earlier work, employing the statistical method in extensive investigations, dealt for the most part with general labor questions where public interest was making the most numerous and pressing calls for information.

The first work of the Bureau of Labor which might be regarded as touching the field of industrial hygiene was the study of workmen's accident insurance and compensation. This was naturally so, from the fact that the consequences of accidents bear most acutely upon the workman and his family, while the effects of unhygienic conditions are more obscure and more gradual, although affecting much larger numbers.

But, strictly speaking, much that is of the greatest value to industrial hygiene comes out of the efforts to prevent accidents and to remedy dangerous and injurious conditions. The first step in any well-considered plan of accident prevention involves a cleaning up of the shop. Safety and sanitation go hand in hand. Attention to measures for safety results directly in improvements in hygiene.

The work relating to industrial hygiene proper was taken up later by the Bureau of Labor, and has been developed as a better understanding has come of the importance of industrial dangers due to the hazards of machinery, dangerous or poisonous materials, or to insanitary working conditions. For views of what dangers must be regarded as necessary, and to be accepted without protest, have changed in recent years, as greatly in the field of industrial hygiene proper, as in the matter of accidents of industry. No longer is the view generally accepted that the employees may reasonably be asked to assume the risks of insanitary employment, but rather that both employers and public authorities have distinct duties to know and to make use of the best practicable methods for the protection of the health as well as the safety of men, women, and children in industrial and other employments.

Classing the work which the Bureau of Labor has already done in what we may call the broad field of industrial hygiene under two heads, (1) accidents and relief and insurance of workmen; (2) factory inspection and occupational or industrial hygiene, brief mention may properly be made first of the reports under the first head:

Relating to accidents and relief and insurance of workmen, more than 20 bulletin articles and reports have been published, beginning with a special report on compulsory insurance in Germany in 1893, the first American publication on the subject, and later covering the legislation, the accident and sickness statistics, and the details of the experience of all the important industrial countries where a system of insurance or compensation for accidents, sickness, invalidity, or unemployment is in force. In addition, several special studies have been made of accidents in selected industries in the United States. One of these deals with the cotton-textile industry and another with the employment of women in the metal trades. A third report, much more detailed and elaborate, is the result of a comprehensive study of accidents and accident prevention in the iron and steel industry in the United States.

In the group of reports relating to factory inspection and occupational hygiene are included articles in regard to the inspection of factories and workshops in this and in foreign countries. The details in regard to factory legislation and inspection, the regulation of working conditions, especially in industries and occupations involving special dangers, have been the subjects of particular attention. Special studies have also been made of the mortality and morbidity in certain dangerous occupations and of the dangers to employees who, in the course of their work, come in contact with certain poisonous materials. Under this head, of the greatest importance are the studies of phosphorus poisoning in the match industry and of lead poisoning in the white-lead industry and in the manufacture of pottery, tiles, and porcelain enameled sanitary ware. In all of these industries investigation has disclosed the existence of dangerous conditions, most of which may be entirely eliminated, or very greatly improved, without serious difficulty. All of these investigations have strongly emphasized the fact that, by a study of working conditions in the more dangerous and unhealthful occupations, the methods and experience of the best factories may be made available for those factories where, because of ignorance or because of indifference resulting from ignorance, dangerous conditions have been allowed to continue without any technical necessity and without any economic need.

Reports and bulletins issued by the Bureau of Labor since January, 1908, relating wholly or in part to industrial hygiene, are as follows:

REPORTS.

Investigation of Telephone Companies. (Printed as S. Doc. No. 427, 61st Cong., 2d sess.) 1910. Includes "Character and severity of the work"; "Care for health of operatives"; "Location and size of operating rooms and air space per person"; "Effect of work upon health of operatives."

Strike at Bethlehem Steel Works, South Bethlehem, Pa. (Printed as S. Doc. No. 521, 61st Cong., 2d sess.) 1910. Includes "Accident record and relief and benefits in cases of accident, sickness, and death."

Report on Condition of Woman and Child Wage Earners in the United States. (Printed as S. Doc. No. 645, 61st Cong., 2d sess.) 1910–1912.

Vol. I. Cotton-Textile Industry. Includes "Hygienic conditions of mills," covering lighting, ventilation and humidity, dust and lint, and spitting on floors; also "Cotton-mill processes and occupations," covering physical conditions and requirements of individual occupations.

Vol. II. Men's Ready-made Clothing. Includes "Health and hygienic conditions" in home work; also "The clothing shop and working conditions," covering ventilation, fire escapes and fire protection, elevators, wash rooms, dressing rooms, water-closets, and lunch rooms.

Vol. III. Glass Industry. Includes "Difficulty and physical strain of the work"; "Working conditions in the furnace room," covering dust and fumes, heat conditions, flooring and its condition, overcrowding, toilet accommodations; "Causes of death of glass blowers and diseases of glass workers"; "Occupations of women and girls"; "Working conditions affecting women and girls," covering lighting, ventilation, and overcrowding, fire escapes and fire protection, wash rooms and dressing rooms, lunch rooms, water-closets, and accidents; "Relation of the work to health" in the employment of women and girls in making incandescent electric lamps, special features of the work and factory and working conditions.

Vol. IV. Silk Industry. Includes "The silk mill and working conditions," covering construction and surroundings, fire escapes and fire protection, light and ventilation, water-closets, wash rooms and dressing rooms, and lunch and rest rooms; also silk-mill processes and occupations, covering the physical requirements of individual occupations, safeguarding of machinery and speeding of machinery, and working conditions.

Vol. IX. History of Women in Industry in the United States. Includes "Health and intensity of labor before 1880 in textile factories."

Vol. XI. Employment of Women in Metal Trades. Includes "Legal provisions against industrial dangers and diseases"; "General factory conditions," covering light and ventilation, removal of dust and fumes, general sanitation, dressing rooms and wash rooms, and lunch rooms; "Distribution of accidents through the hours of the day"; "Speed of production from hour to hour."

Vol. XII. Employment of Women in Laundries. Includes "General conditions of the workrooms in laundries," "Character of the work in power laundries by occupations," "Effect of laundry work upon health."

Vol. XIII. Infant Mortality and Its Relation to the Employment of Mothers.

Vol. XIV. Causes of Death Among Women and Child Cotton-mill Operatives. (In press.)

Vol. XVIII. Employment of Women in Selected Industries. (In press.) Includes Physical conditions and requirements of the work in many industries and occupations.

Vol. XIX. Labor Laws and Factory Conditions. (In press.) Includes Analysis of laws and text of laws relating to factory inspection and employment of women and children; also, Conditions existing in typical factories in 17 States, covering legal age, prohibited employments, hours of labor, night work, safeguarding, accidents, comfort of employees, and ventilation and sanitation.

Report on Conditions of Employment in the Iron and Steel Industry in the United States. (Printed as S. Doc. No. 110, 62d Cong., 1st sess.) 1912.

Vol. III. Working Conditions and the Relations of Employers and Employees. (In press.) Includes Physical conditions and requirements of various occupations; Plans for eliminating the 7-day week and the 12-hour day, overtime work, working conditions and efficiency as affected by heat, working conditions and efficiency as affected by speed and severity of the work, character and severity of the work in 1895 and in 1910.

Vol. IV. Accidents and Accident Prevention. (In press.) Detailed study of accidents by departments and occupations covering rates per 1,000 employees, duration of disability, nature of injury, hour of the accident, causes of accidents, relation to night work, relation to long hours, relation to inability to speak English, safeguarding methods, development of safety work, etc.

BULLETINS.

No. 75. March, 1908. Industrial hygiene, by George M. Kober, M. D.

No. 79. November, 1908. Mortality from consumption in dusty trades, by Frederick L. Hoffman.

No. 80. January, 1909. Woman and child wage earners in Great Britain, by Victor S. Clark, Ph. D. Includes Laws and regulations in dangerous and injurious trades and processes, half-time system as affecting health of child workers, influence of factory acts upon the general welfare of workers.

No. 82. May, 1909. Mortality from consumption in occupations exposing to municipal and general organic dust, by Frederick L. Hoffman.

No. 85. November, 1909. Review of labor legislation of 1908 and 1909, by Lindley D. Clark. Laws of various States relating to labor enacted during 1908 and 1909. Include laws relating to factory inspection and industrial hygiene.

No. 86. January, 1910. Phosphorus poisoning in the match industry, by John B. Andrews, Ph. D. List of industrial poisons, prepared for the International Association for Labor Legislation by Drs. Th. Sommerfeld, Thomas Oliver, and Felix Putzeys. International Association for Labor Legislation and its publications. (Brief description of the work of the association and bibliography of its publications, many of which relate to industrial hygiene.)

No. 89. July, 1910. Child-labor legislation in Europe, by C. W. A. Veditz, Ph. D. (includes legislation and regulations as to hygiene and safety, prohibited occupations, rest periods in working day, effect of home work on children, factory laws and regulations, factory inspection, in Austria, Belgium, France, Germany, Italy, and Switzerland).

No. 91. November, 1910. Working hours of wage-earning women in selected industries in Chicago, by Marie L. Obenauer (includes long hours and physical character of work). Review of labor legislation of 1910, by Lindley D. Clark. Laws of various States relating to labor enacted during 1910 (includes laws relating to factory inspection and industrial hygiene).

No. 92. January, 1911. Resolutions of Sixth Delegates' Meeting, International Association for Labor Legislation (includes administration of labor laws, child labor, night work, hours of labor, industrial poisons, work in compressed air, prevention of accidents, workmen's insurance). Report of Illinois Commission on Occupational Diseases. (Summary of report.)

No. 95. July, 1911. Industrial lead poisoning, with descriptions of lead processes in certain industries in Great Britain and the western States of Europe, by Sir Thomas Oliver, M. D. White lead industry in the United States, with an appendix on the lead oxide industry, by Alice Hamilton, M. D. Deaths from lead poisoning (actually reported) in New York State in 1909 and 1910, by John B. Andrews, Ph. D. Laws enacted during 1911 requiring the report of occupational diseases.

No. 96. September, 1911. Working hours, earnings, and duration of employment of women workers in selected industries of Maryland and of California, by Marie L. Obenauer (includes long hours and high-pressure methods, physical character of work, and sanitary conditions). Employment of children in Maryland industries, by Marie L. Obenauer and Mary Conyngton (includes long hours and physical character of work). Attitude of Massachusetts manufacturers toward the health of their employees, by Wm. C. Hanson, M. D.

No. 97. November, 1911. Review of labor legislation of 1911, by Lindley D. Clark. Laws of various States relating to labor enacted during 1911 (include laws relating to factory inspection and industrial hygiene).

No. 98. January, 1912. Conciliation, arbitration, and sanitation in the cloak, Clark. Laws of various States relating to labor enacted during 1911 (includes detailed study of work and methods of joint board of sanitary control).

No. 100. May, 1912. List of industrial poisons and other substances injurious to health found in industrial processes, prepared by Dr. Th. Sommerfeld and Dr. R. Fischer and edited by the permanent advisory council of hygiene of the International Association for Labor Legislation. Act providing for a tax on white phosphorus matches and prohibiting their import or export.

No. 101. July 1, 1912. Care of tuberculous wage earners in Germany, by Frederick L. Hoffman.

No. 104. August 7, 1912. Lead poisoning in potteries, tile works, and porcelain enameled sanitary ware factories, with appendix on hygienic conditions and regulations in potteries, tile works, and enameled sanitary ware factories in Great Britain, Germany, and Austria, by Alice Hamilton, M. D. (In press.)

The following studies relating wholly or in part to industrial hygiene are now being carried on:

Lead poisoning and methods of its prevention in the various lead-using industries and occupations. On this subject two studies have already been published, one relating to white and red lead factories, and the other to potteries, tile works, and porcelain enameled sanitary ware factories.

Causes of death in the various occupations of the cotton textile mill.

Employment of women in laundries: An intensive study of the problems of heat and humidity, and severity and strain of laundry work with special reference to their effect upon the health of the women employed and to the extent to which existing conditions are necessary.

Employment of women and children in pea canneries: An intensive study of the requirements of the industry, the factory equipment, and the labor supply as related to the need of long working hours; also speed, severity, and strain of the work of the various occupations.

Foreign labor legislation (to include laws in the principal industrial countries in regard to factory hygiene and inspection, especially those regulating the use of industrial poisons or dangerous or injurious materials, the prevention or disposal of dust or fumes, and the methods for providing for safeguarding the health and safety of workers).

Other studies relating to industrial hygiene will be taken up as the means and force of the bureau will permit. Among those which it is expected will be taken up during the coming year are the following:

The methods and standards of factory inspectors in the various States.

Women in industry. Studies similar in character to those already made Emphasis will be placed more and more on the conditions and requirements of the work, as in the recent studies relating to laundries and canneries.

Mortality and morbidity among workers in various industries and occupations. Much valuable material in regard to this subject exists in the records of the trade unions and of the fraternal benefit organizations.

Regulations of various countries for improving industrial hygiene and safeguarding health of workers.

The foregoing list will give a fairly clear idea of what the Bureau of Labor has already done and is now doing in the field of industrial hygiene, and the dates of publication will show how that work has been developed and broadened and given more practical application in the last two years. The object kept constantly in view, especially in the more recent specialized studies, has been not only to ascertain the exact facts as to factory conditions endangering the health and safety of employees, but also how far such conditions are necessary to the conduct of the industry, and what practical concrete suggestions are possible to materially improve conditions.

Within the field of industry, the Bureau of Labor should be able to perform for industrial workers a service similar to that done by the Agricultural Department for the fruit grower, the stock raiser, and for other departments of agriculture. The dangers to the health and safety of workers which are incident to industrial employments should be regarded as problems calling for constant research and study in this and in other countries, in order that the safest and best methods may be known and placed at the disposal of employers and employees, and that the health and safety of the people may be conserved in the greatest possible measure.

STATE COMMISSIONS ON OCCUPATIONAL DISEASES.

Prof. CHARLES R. HENDERSON, University of Chicago.

This paper does not pretend to give a complete history of public efforts in this country to investigate diseases of industry, to agitate for legislation, and to organize administration. It aims to supply materials for a certain section of that history which ought to be carefully prepared and published.

The examples chosen will serve to illustrate: (1) The type of temporary and occasional exploration; (2) permanent central administrative agencies created by law; (3) the relation of State to Federal investigations.

I. TEMPORARY COMMISSIONS FOR EXPLORATION.

Naturally, the foundation for this whole movement was laid by the systematic studies of medical men who have given special attention to industrial hygiene. Conspicuous among the benefactors of the race was Ramazzini, whose memory should be revived in the thought of all who devote themselves to the welfare of productive operatives in our age.[1]

It would be interesting to gather up the materials for a history of the contributions of various professors of the healing science and art since the days of the great Italian pioneer; but that is not attempted in this paper. As a layman who has long sought the guidance of physicians in his labors for social legislation it is my desire to record a word of admiration, praise, and appreciation of the long line of useful and illustrious medical men who in this great field have served the toilers and made mankind their debtors. They have rarely had other rewards for this service than those which come to the scientific man in the discovery of new truth, and to the benefactor in the satisfactions of his sympathies and his conscience.

It is quite often necessary, when evils are hidden and unrebuked, to secure public authority to drag them forth into the light of common day and expose them to the public in all their ugliness. Individuals working alone are unable to secure a hearing; their opinions are treated as academic, eccentric, and beneath the attention of practical men. But an inquest authorized by the legislature confronts politicians with an issue which can not be set aside and gives to the press a topic and materials for discussion. The value of a temporary commission created for a particular inquiry lies: (1) In the discovery of the serious dangers to which workmen are exposed, and of which neither they nor their employers are fully, if at all, aware; (2) in securing a wide cooperation of medical practitioners throughout the State, with a view to instructing patients, warning workmen, and creating public sentiment; (3) in securing improved legislation enlarging the powers and duties of factory inspectors and health authorities to cover the protection of work people in mines, mills, shops, factories, and mercantile establishments.

THE ILLINOIS COMMISSION ON OCCUPATIONAL DISEASES.

The General Assembly of Illinois in May, 1905, by unanimous vote of both house and senate, passed a resolution which authorized and requested the governor of the State to appoint a commission consisting of five representative men to serve without remuneration, whose duty it should be to investigate and report a draft of a bill providing a plan for industrial insurance and workingmen's old-age pension for consideration and action of the next general assembly. This commission made its report in 1907. Its recommendations were not acted upon, as the time was not yet ripe for social insurance legislation; but the labors of the commission bore fruit later, and a compensation law, covering industrial accident injuries only, was enacted by a subsequent legislature.

In the course of their report this commission said:

> Undoubtedly the time is not distant when industrial States must take up the problem of legislation upon sick insurance. To provide a scientific basis for such legislation, we recommend the appointment of a competent commission having the power and the means to make a thorough study of the kinds, causes, and extent of diseases among work people and the most modern methods of protection, prevention, and insurance.

The medical profession was not represented in this first commission; but it considered the situation in European countries, especially in Germany, and urged the necessity of a scientific study of occupation in relation to sickness. The word "competent" implied that the commission on occupational diseases ought to be composed chiefly of physicians.

Very soon after this report was presented, that is, in March, 1907, the Legislature of Illinois acted upon the recommendation of the industrial insurance commission, and authorized the governor to appoint a commission of nine members, to be composed of the State factory inspector, the secretary of the bureau of labor statistics, the president and secretary of the State board of health, two reputable physicians, and three other representative citizens of the State, who should serve without remuneration, and whose duties should be to thoroughly investigate causes and conditions relating to diseases of occupation, and to report a draft of a bill for the consideration of the assembly. Mr. Edgar T. Davies, the efficient chief factory inspector of Illinois, was active and effective in securing this legislation.

The governor appointed the commission, which could not, for various reasons, begin its work until the early part of the year 1910, and was obliged to close its study in December. The legislature provided $15,000 for the expenses of study and publication. Several very able physicians were employed to conduct the investigations. Dr. Alice Hamilton made a special investigation of poisoning by lead, arsenic, and mercury in the industries of Illinois. She was appointed on the commission, but resigned to take up the work of investigation.

Dr. E. R. Hayhurst, assisted by O. F. Funkhouser, M. D., and F. E. Flinn, M. D., with several investigators as assistants, studied conditions in brass foundries and other shops where lead poisoning might be expected. Dr. P. F. Becker investigated records of two hospitals for the insane to discover whether the influence of lead poisoning was discoverable there. Dr. Matthew Karasek and Dr. George L. Apfelback made an examination of the effects of gas poisoning in steel works, foundries, tailor shops, and so forth. Dr. Peter Bassoe gave attention to caisson disease. Dr. George E. Shambaugh studied cases of boilermakers' deafness. Dr. Francis Lane and Dr. John B. Ellis examined many miners for nystagmus. Medical members of the commission who selected the subjects for study directed the procedure, tested the results, and formulated the special reports were: Drs. George W. Webster, Ludvig Hektoen, Walter S. Haines, W. H. Allport, and James A. Egan. Dr. A. C. Klebs resigned because of absence from the country. Mr. James Simpson, Mr. David Ross, and the writer were other members of the commission.

With few exceptions the establishments visited received the representatives of the commission with courtesy and aided them in their work.

The report of the committee was printed in a pamphlet of 219 pages, and laid before the governor and legislature in January, 1911. It contained a brief statement of the scope and field of industrial hygiene, including the closest possible estimate of the number of workmen exposed to industrial poisons in the industries of Illinois; also a list of industrial poisons and means of alleviation. It discussed the principles of effective legislation for the prevention of diseases of occupation, as made clear by European experience and medical science, and the administrative organization necessary to give effect to legislation. It showed that after all possible preventive methods have been used there will unavoidably remain a "trade risk" of injury which must be relieved by social insurance. It recommended that some commission, provided with larger funds, should continue this exploration for two years longer, because it was impossible for it to finish its task.

The reasons given for this request were as follows:

> We have in this report furnished abundant facts to demonstrate both the necessity and utility of further investigation. * * * It is a public and not a class interest. Such an investigation is required: 1. To furnish to the medical profession the facts which they need for their guidance in the prompt discovery of the industrial causes of many diseases. A treatment of symptoms. which ignores shop conditions and the gradual and insidious introduction of poisons into the body. is likely to fail. 2. The knowledge thus acquired will be useful to employers of labor. We here assume that no reputable manufacturer will deliberately plan to poison or kill those who are in his service. But we have already abundant evidence that employers are actually keeping work places in conditions which must inevitably result in sickness, weakness, pauperism, death. and sometimes means are known which would remove at least part of the danger. * * * 4. The burden of the diseased, crippled, and disabled workmen finally falls on the community; and the community. in self-defense, must inquire into a scientific way for the causes of that burden. to learn how to diminish its weight. 5. The employees in manufactories and their families are vitally interested in this whole matter. With them it is not merely a question of more or less money. but literally of life or death. * * * The whole people is concerned when any group of the membership is exposed to disease. * * * A constructive. protective. far-sighted public policy can not be initiated and sustained without a broad basis of facts ascertained by a thorough investigation in the hands of competent investigators. who have special training in this kind of inquiry.

The reports of the investigators were printed in full detail, and considerable information was published for legislators, physicians, and employers.

The report bore fruit immediately, and in the following law the legislature extended its protective measures to include prevention of injuries to health from conditions in work places:

An Act To promote the public health by protecting certain employees in this State from the dangers of occupational diseases. (House bill No. 250, approved May 26, 1911.)

Section 1 requires employers to adopt reasonable and approved devices, means, or methods for the prevention of occupational diseases which are incident to a work or process which presents dangers to health.

Section 2 declares specified trades, in which white lead is used, to be especially dangerous to the health of the employees, and requires the provision and use of facilities for cleanliness and of respirators where dust is created.

Section 3 requires periodical medical examination of workmen exposed to lead poison.

Section 4 makes it the duty of physicians to report cases of disease to the State board of health. Other devices and precautions are stipulated in detail, and the State department of factory inspection is required to enforce the provisions of the act. Notices of the dangers to which employees are exposed are to be posted in the places of employment. Suitable penalties are provided as sanctions of the commands of the law.

One of the results of the report was the addition of persons of medical training to the ordinary staff of factory inspectors. It was made very clear by inquiry that laymen can not detect occupational diseases nor trace their causes. Even physicians must have special training and experience to be effective. The need of a museum and clinic was only too apparent, and the Milan institution excited our envy. We are again indebted for a great idea to the land of Ramazzini.

The New York factory investigating commission is a good example of the temporary organization for exploration of conditions. It is no reflection on the department of labor that such an inquiry should be thought necessary. A department of inspection must confine itself to a circle of duties prescribed and limited by the law creating it, and it can not well enter other fields, however great the necessity and demand. An exploring commission has much wider range of investigation. The preliminary report of this New York commission states the legal basis of its work in this proposition:

> The State not only possesses the power and the right, but it is charged with the sacred duty of seeing that the worker is properly safeguarded in case of fire; that he is protected from accidents caused by neglect or indifference; that proper precautions are taken to prevent poisoning by the materials and processes of his industry; and that he works under conditions conducive to good health and not such as breed disease.

This commission is not composed of medical men, but appointed Dr. George W. Price to conduct the investigations into sanitary conditions. The immediately exciting cause for the appointment of the commission was a tragic conflagration in which the fire risk was sensationally prominent and engineering problems were primarily considered. As the study advances the less spectacular but more constant and insidious dangers of disease secure a larger share of attention.

II. PERMANENT CENTRAL DEPARTMENTS HAVING DUTIES RELATING TO OCCUPATIONAL DISEASES.

For many years the University of Wisconsin has quietly but strongly done its duty and made its influence felt in persuading legislators to act on rational, scientific grounds, rather than from blind instinct and with incomplete information. One of the results of this persistent effort is the creation of a bureau for collecting facts for the lawmakers; another is the industrial commission.[2]

This commission is composed of three members.

> The legislature lays down the general rule that every employer shall furnish to his employees the necessary protection to life, health, safety, and welfare. This places the obligation on the employer * * *. But it is not left to the employer to tell what are those safe methods and processes nor is it left to the factory inspectors. To the industrial commission is assigned the duty of investigating and ascertaining what safety devices and safeguards, what means, methods, and processes are best adapted to render the factory safe. Having ascertained what they are, the commission issued an order prescribing that they shall be installed for each factory or each class of factories.

If an employer is dissatisfied with a report of an inspector he can appeal first to the commission and then to the courts. The employers are heard when general rules are adopted by the commission.

MEDICAL *v.* LAY DIRECTION OF ADMINISTRATION.

Among the forms of permanent State administration of shop hygiene and sanitation there are two types, namely, the medical and the lay control; one related to the health department, the other to factory inspection and the labor bureau. The history of the particular State accounts for the origin of each type.

A good deal can be said in favor of medical control. Matters of injury to the body, whether from so-called accidents or from poisons, should evidently come under the trained observation of a physician at the earliest possible moment. Whether we consider causes, conditions, symptoms, effects, remedies, or prevention, it is the physician who should have the decisive word. The merely mechanical side, machines and devices for protection, can certainly be quite as well understood by a physician, after some experience, as by the average inspector. Where technical questions are involved, it is not difficult to provide engineers or skilled mechanics.

Nor is it seemly to subordinate educated and skillful physicians to others. Their superior knowledge should have corresponding respect and not be liable to be set aside by a superior in rank who can not understand the reasons for a doctor's orders.

The Massachusetts plan, therefore, is recommended by the principle of control by experts. This plan has the great advantage that it solves the problem of civil service examinations and freedom from the spoils system, for the diploma from a medical college recognized and approved by the State is a guaranty at least of education for the essential work of the office of inspector. There are, of course, political appointments of doctors, but the danger is certainly small in comparison with that in the ordinary system. It goes without saying that even a physician must serve an apprenticeship under an experienced inspector.

If it is claimed that the appointment of an occasional medical inspector is sufficient, we may express doubt. The subordinate position is not attractive to a capable man in the medical profession and will tend to draw only from the inferior grade.

When shop hygiene is a part of the care of a State department of health it is closely related to the whole system of public sanitation and hygiene. The shop, the home, the street, public conveyances, sewerage, are all closely related to the health of workingmen. I would seem natural, therefore, to bring shop hygiene under the general control of the medical division of the State administration.

Much can reasonably be said in favor of the system in which shop hygiene is made a function of the State department of labor. It is necessary to have a corps of inspectors to prevent accidents and to enforce laws relating to child labor and to hours of labor. Conditions of health are inextricably linked with conditions of safety, comfort, and convenience, and it seems to many that all should be subject to one control.

It is now admitted that inspection must have the services of specialists, not only in medicine but in trade processes; the technical processes of a mine are unintelligible to an inspector of woodworking, painting, or printing. The medical inspector thus comes to be regarded as just one more specialist.

To overcome the difficulty of securing thoroughly competent direction of the medical side of inspection where laymen are in control, and to promote scientific research of causes of occupational disease, it would seem wise to appoint distinguished directors of laboratories as members of a consulting staff to advise with the department of labor. This would lift the work of the department out of deadening routine and bring into the ordinary procedure the spirit of fervent and eager, alert inquisitiveness which keeps the administration alive. In some such way as this every shop hospital would become a clinic in occupational diseases and a school of medical instruction. Experience has proved that this of itself attracts the attention and interest of the most able men of science in the medical profession, who have hitherto, in this country, too much neglected this realm of their art.

The Federal Bureau of Labor and the projected bureau of health have a function of vast importance in the field of investigation. Here again will arise the problem of a proper division of labor between two classes of expert investigators, the medical and the industrial; but an adjustment will be reached and the vast resources of the Nation will be brought into the campaign against ignorance and disease.

In the State investigation of lead poisoning it was found that the mines were in one State while the chief industries using lead as raw material were in others, and that the transporting agencies extended everywhere, all being exposed to peril. It is inevitable and desirable that the Federal authorities shall not only investigate conditions, but also use the national legal power to control the danger from poison incident to interstate commerce.

APPENDIX.

The department of labor of New York has improved its service by introducing medical inspection and laboratory work. The report of Mr. John Williams, commissioner, for 1911, says that intensive work in the field of industrial hygiene has been pushed forward, and that definite methods for analytical investigations to determine dangerous factors incident to the various industries have been adopted. Deputy Factory Inspector Vogt, formerly a sanitary inspector in the State health department, was assigned to this division, and a splendid library has been placed at the disposal of the department for research. Already encouraging results have been secured.

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[1] My copy of his work is entitled: "Bernardini Ramazzini, in Patavino Gymnasio Practicae Medicinea Professoris Primarii de Morbis Artificum Diatriba, Mutinae olim edita. Patavii Kal. Sep. 1713; pp. 470–687 of Bernardini Ramazzini, Opera Omnia, etc. Genevae, MDCCXVII; Cramer et Perachon.

[2] Paper of John R. Commons, American Labor Legislation Review, vol. I, No. 4.

GOVERNMENT STUDY OF OCCUPATIONAL DISEASES.

Prof. JOHN R. COMMONS, of the Industrial Commission of Wisconsin.

We concede that in legislation and administration for the protection of health and safety of employees we are behind the nations of Europe. This is due partly to ignorance through lack of investigation, partly to piecemeal legislation that hits one evil at a time when it gets sufficiently exposed, partly to the veto of our courts.

But the courts have begun to recognize another branch of government. This branch has come forth especially to provide for that extension of the police power required to meet the rapidly changing and widely varying conditions of modern life and business. It therefore combines, to a certain degree, the activities of legislation, execution, and judgment; but its peculiar activity, which gives it a separate place as the custodian of the police power in the body politic, is that of investigation.

The doctrine which the court applies to this function of investigation is both the noblest and the most practical of legal doctrines—reasonableness. By this doctrine the court applies its philosophy to the particular facts, but requires that all of the facts be taken into account. It may be that the critics of the judiciary have not performed their part in bringing before the court all of the facts of the modern development of industry and society which the doctrine of reasonableness requires. Counsel often leaves the court in the predicament of falling back on its own knowledge of what is "common knowledge." Often this kind of knowledge is several years behind the times, because a serious injury to the common good usually arises and spreads extensively before the scientific experts and the journalistic agitators are able to make it a matter of common knowledge. The investigative branch of government should be the one that furnishes the court with judicial knowledge of injury to the public in advance of common knowledge. Being also an administrative branch, it should carry over promptly the results of scientific investigation into their practical application. Its function of the police power is the power of reasonable regulation through constructive investigation.

The several States and the Federal Congress have recently sought in various fields to elevate this work of investigation to the high position in our frame of government that the courts had assigned to it in the procedure of government. The legislatures had previously, from time to time, broken up the executive department by creating separate departments to execute specific commands of the legislature. Usually a single officer was placed at the head of each of these departments, until a great variety of minor executives had arisen, such as the health officer, the factory inspector, the railroad commissioner, and so on.

At the same time, the legislature attempted to enumerate in detail the things that each officer should do and each citizen obey. Two difficulties appeared. The courts often declared their elaborate laws unconstitutional, as being unreasonable, and the executives were restrained from dealing with any specific evil that the legislature had failed to enumerate. These difficulties first appeared in the health department, and the legislatures proceeded to change the character of that department by creating a board of physicians, with power to issue orders based on their expert knowledge, and having the force of law, though not enumerated in the law. Next, in the regulation of railroads, instead of the detailed schedules of rates that characterized the early Granger laws, the legislatures advanced to the position which culminated in the railroad and public utility laws of Wisconsin, of merely declaring (what the courts had already declared) that rates and services should be "reasonable," but creating a commission, with powers of investigation equal to those of the courts, to discover and announce, in each case as it arose, what was the reasonable rate or service. Where the investigations of the courts are limited by the technical rules of testimony, the commission can investigate, on its own initiative and in its own way, all the circumstances that it considers relevant. In fact, the commission is made a kind of standing referee to the court, directed by the legislature to report all of the facts that go to determine what is reasonable. Instead of a referee appointed by the court, usually a lawyer, with the lawyer's limitations as to the relative value of different facts, the commission is a body of men compelled by their duties to give weight to social and economic facts that otherwise do not get before the court.

Wisconsin has now ventured to adopt this same principle in matters of labor legislation. Instead of the long list of dangerous points, such as set screws, belts, fire escapes, dusts, and so forth, which successive legislatures had accumulated during the past 30 years, the new law expresses the general will in the most general way, as the duty of the employer to safeguard the life, health, safety, and welfare of employees and frequenters, and the duty of employees to cooperate with their employers.

The law applies as broadly as possible, not to enumerated factories and shops, but to all "places of employment," except agricultural and domestic employments not using mechanical power. In effect, all physical property used to furnish employment to labor is declared to be "affected by a public use," and must be so managed as to promote the public welfare in the persons of those who come within its zone of danger.

The definition of safety is not that of the "ordinary" safety of the common law, but "such freedom from danger to the life, health, or safety of employees or frequenters as the nature of the employment will reasonably permit." The definition of welfare is "comfort, decency, and moral well-being."

Here, then, is the field of investigation assigned to the commission. It must call to its aid scientific experts in engineering and hygiene. It must ascertain where danger lies and where life, health, safety, and welfare are menaced. It must discover the devices, processes, and management that will avoid these dangers, and must ascertain whether they are practicable. This is that constructive investigation that conforms to reasonableness. Once ascertained and published as an "order" of the commission, the conclusions of its investigations have the force of law, the will of the legislature is executed, and the philosophy of the court is observed.

When the commission began its work of selecting its staff, it had entertained the idea that it should place engineering and medical experts at the head of its safety and sanitation work. But, after interviewing a number of these experts, it was discovered that they considered their problem to be that of drawing up ideal or standard specifications, which the commission should then go out with a "big stick" and compel employers to adopt.

For two reasons this was decided to be impossible. A monarchical country, like Germany, with its executive independent of political changes, might call in its experts and be governed by them, but a democratic country would not consent to be ruled by those whose ideal standards might be removed from the everyday conditions of business. This decision of the commission also conforms to the doctrine of reasonableness, which requires practicability adapted to existing conditions. It was found that most of the successful work in safety and sanitation during the past 10 years had not been in charge of technical engineers, but had been in charge of shopmen or even claim agents of the corporation; and their success had come about not mainly through their knowledge as mechanical experts but through their ability to get the services of engineers and medical men when needed, and especially their ability to get the cooperation of superintendents, foremen, and workmen in a united effort to stop accidents and preserve health. In other words, they were experts in arousing the spirit of "safety first" and in organizing the shop so as to keep that spirit on top. For scarcely a third of the accidents can be prevented merely by mechanical safeguards—at least two-thirds must be prevented by attention, instruction, and discipline.

It is also this spirit of safety among the shopmen that brings out the most effective safeguards—effective in the sense of full protection without interfering with output. The engineer can devise safeguards; he needs the shopman to safeguard the output. The "safety expert" is the one who can bring these two elements together and thus work out the practical rules for the commission to adopt. He guides the investigators who determine what is "reasonable," both in the shop and in court. It is for this reason that the Wisconsin commission has not been able to follow the remarkable and extensive safeguards devised and enforced in Germany. They seem to lack that element of "practicability" which the shopman, as distinguished from the technical expert, insists upon.

But in the arrangement finally decided upon the scientist, the engineer, the physician, the sanitarian, who are the technical experts, are called in and utilized just as they are in private employment when their services are needed and when the practical men have problems beyond their technical knowledge. If, however, the scientists dominated the investigations their results, however brilliant and conclusive, might not be reasonable. Their investigations are indispensable and fundamental and must be taken into account and should be liberally provided for. But unless they lead to practicability, which only can be supplied by the practical man, they run the risk of unconstitutionality.

Constructive investigation differs from scientific investigation in that it must be guided toward practical ends under existing conditions. The distinction is vital in America, if not in Europe, for that which is scientific may be unconstituional because not reasonably practical.

But the selection of a proper staff is not enough to insure practicability. The Wisconsin law authorizes the commission to appoint "advisors" without compensation to assist the commission in any of its duties. Acting on this authority the commission invited the Wisconsin Manufacturers' Association and The Merchants' & Manufacturers' Association of Milwaukee as well as other associations of special trades, such as the master bakers, the woodworkers, and so forth, to name representatives; also the State Federation of Labor, the employers' liability insurance companies, and the Mutual Employers' Liability Association, organized on the German model, under the compensation law; and, in addition, the commission invited certain corporations which had done the best safety work in the State to permit their safety experts to meet with the committees.

The commission also secured the assistance of physicians on special subjects of the chief sanitary officers of the cities of Milwaukee and Chicago, of the State board of health, and the State hygienic laboratory, and representatives of the Consumers' League and the State Federation of Women's Clubs. These various representatives were grouped into a main committee on safety and sanitation, with subcommittees on boilers, elevators, bakeries, sanitation, and so on and deputies of the commission were assigned to work with them. In this way the commission has had the assistance of scientific experts, of representatives of the interests affected by the orders to be issued, of representatives of the public as consumers, of representatives of overlapping agencies, such as insurance companies and boards of health, and of its own experts. This, too, has brought to the commission the assistance of some of the leading men of the State in their several lines of work. These men have given an astonishing amount of time at their own expense, which, if paid for at commercial rates, would have required an expenditure far beyond the appropriation which the legislature allowed to the commission. Such men have looked upon their work, not merely as a public service, but mainly as a vital matter in the future conduct of manufacturing in the State. The list of advisory committees indicates the wide range of representative and expert men to whom the commission and the State are indebted for this fundamental part of its work.

These committees proceed to make their investigations, to draw up tentative rules, and to submit them to the commission for public hearings. After the hearings the rules are referred back to the committee for further investigation and, finally as rapidly as completed, are issued by the commission as "general orders" applying to the entire State and are published in the official paper and in the bulletins of the commission.

The fact that both the law and the commission contemplated the cooperation of employers and employees has resulted in a code of rules which are not only reasonable in law, but reasonable in the minds of employers. It is an application of the well-recognized principle of political economy that the competition of the worst employers tends to drag down the best employers to their level. In this case, however, the corollary law is sought to be brought into play. The most progressive employers in the line of safety and sanitation draw up the law, and the business of the commission is to go out and bring the backward ones up to their level. As a matter of fact, it has been found that the employers on the committees have been more exacting in their search for the highest practicable standards than the representatives of labor on the committees. As a consequence the work of the commission in bringing other employers up to their level has been almost entirely transformed from what they considered an irritating and arbitrary interference in their business into a work of instruction and education. The employer who resists the adoption of safeguards and processes approved by his fellow employers is not only unreasonable in the opinion of his peers, but prima facie unreasonable in court.

DISCUSSION.

EDGAR T. DAVIES, Chicago, Ill.: I shall be glad to be informed by some member of this congress concerning the amount of money appropriated by the various State legislatures for the purpose of enforcing enactments for the prevention and elimination of occupational diseases, and for the promotion of industrial hygiene in general. Take, for instance, the highly responsible duties devolving upon the industrial commission of Wisconsin. What financial support is guaranteed for carrying out these admirable provisions? We, as individual States, have spent large sums of money, and we have accomplished much in reducing the dangers attendant upon hazardous occupations, but in a closer interchange of knowledge concerning what other States are doing lies the possibility of greater accomplishments by means of judicious cooperation.

EFFECTS OF INDUSTRIAL STRAIN ON THE WORKING WOMAN.

ROSALIE SLAUGHTER MORTON, M. D., New York City.

In reviewing the literature on the hygiene of occupation, I have been interested to observe that much of the most able and comprehensive work has been done by women, and also that physicians have given much gratuitous time to an analytical study of this subject.[1]

What has been done shows the great desirability of the appointment, under a National department of Health, of a commission to make a systematic study of industries and their various forms of strain on normal women of different ages and types. Such a study would involve the detailed consideration of modifying factors which are necessary in order that accurate deductions may be made from statistics. For instance, present records show a high percentage of tuberculosis among both men and women working in tobacco. Unquestionably they are affected by the irritation of dust and fumes which render them susceptible to various derangements, especially bronchial catarrh, which lessens their resistance to tuberculosis; but, on the other hand, stripping, sorting leaves, rolling stogies, and so on, is not as strenuous as some other forms of work; so many who already have tuberculosis seek employment in tobacco factories.

The available data on a number of trades show the value to the business and social welfare of the world, as well as to the individual, of wisely conducted industry, for, to become truly constructive to the state, it must be profitable both to the employer and employee.

The regulation of work to an eight-hour day has proved necessary for men, in order that they may retain their efficiency, and such regulation of hours for women is equally necessary. Shorter hours and fairer pay would lessen the effects of industrial strain upon the working women, both individually and eugenically, to an extent which would raise the health and efficiency of our race at least 70 per cent. Factory and other nondomestic industry is not in itself a menace to women; in fact, in many instances a woman's physical and mental health is better when she is engaged in a regular and impersonal form of work.

Statistics from insane asylums and life-insurance companies show that a higher percentage of insane come from the class of domestics and housewives than from women in trades and professions, and that longevity among women has increased during the last 25 years. Most of the women who break down from work do so from causes which are in no way related to sex. In gathering information for this paper, I found that the average of temporary illnesses in three New York department stores shows that the number of employees who seek relief in the hospitals located in the stores is divided between men and women in about equal ratio to those employed. Of the women patients, approximately one-third suffer from headache, one-third from indigestion and miscellaneous ailments, and only one-third have menstrual disorders, making a very small proportion out of the total number of employees. For instance, in a store which employs 3,000 women, there will average not more than 10 a day who come to the rest room or hospital for a few hours on account of dysmennorrhea. In one of the stores, which employs approximately 3,500 women, the nurse who had been in attendance for 8 years said that she knew of only 15 cases of permanent pelvic trouble brought on by work in the store. In one store, which is situated at the junction of several surface and elevated street car lines, the daily attendance in the store hospital is double that of a store in a more quiet location. The ventilation of the former store is also poorer than in the latter. The proportion of those who suffer from dysmennorrhea is larger in the store which is not so well ventilated and which is noisier, showing that general hygiene has its effect upon a woman's health during her period. A point which is often overlooked when statements are made regarding the endurance of women as a class is that their lower wages do not enable them to purchase such sustaining food as men customarily have. For instance, the average amount paid for their lunch by women in shops, factories, and clerical positions is 15 cents; the average paid by men in the same lines of work is 30 cents. The consequent lack of nutrition in a very short time lessens the endurance of women workers. Among the 3,800 employees in the head office of the Metropolitan Life Insurance Co. absences on account of illness have been conspicuously reduced since the company has provided a substantial lunch for them, and a similar result has followed this wise economic step taken by other employers.

On the general subject of hygiene in relation to industry, many significant deductions may be made which apply to women workers in their homes, in colleges, in professions, in shops, and in factories, showing that their endurance, capacity, and output are influenced by mental and physical hygiene rather than by sex. The papers which have been or will be read before this congress direct intensive thought toward many details of industrial strain which are applicable as much to the working woman as to the working man; in fact, according to the schedules of the Twelfth Census (1900), we find women in 295 out of the 303 separate employments there tabulated. The general headings given are: Agriculture, professional service, domestic and personal service, trade and transportation, manufacturing and mechanical pursuits. The eight employments in which no women are recorded are: Soldiers of the United States, (2) sailors of the United States, and (3) marines of the United States, (4) street car drivers (though two women are reported as motormen), (5) firemen (in the fire department), (6) apprentices and helpers to roofers and slaters, (7) helpers to steam boiler makers, and (8) helpers to brass workers.

It may be of passing interest and, perhaps, a surprise to note that a limited number of women were registered in unusual occupations; 5 women were employed as pilots on steam railroads, 5 as baggagemen, 31 as brakemen, 7 as conductors, 35 as engineers and firemen, and 26 as switchmen, yardmen, and flagmen; 6 women were reported as ship's carpenters, and as many as 181 were reported as blacksmiths, and 508 as machinists; 8 as boiler makers, 31 as charcoal, coke, and lime burners, and 11 as well borers.

The laws, or lack of them, for the protection of women's health and the occupations in which women suffer from lack of fresh air or proper light, too great heat or cold, speeding up, inhalation of irritating dust and gases, et cetera, and the effects of these various forms of industry, have been so comprehensively presented to you that anything I might say would be in large part a repetition; therefore, I will confine my paper to the especial effect upon women of trades which involve prolonged and unnecessary standing, the pushing of heavy trucks from room to room, as in the larger canneries; the constant carrying of heavy weights, as core makers in foundries, who carry trays of sand cores weighing from 10 to 50 pounds from work benches to ovens; or operating machinery by treadle pressure, with incessant kicking, as in a case cited by Dr. Caroline Hedger, where, in assembling screw drivers, a girl kicked 7,000 times a day with one foot. Violent treadle pressure, as in button-stamping machines, perforating presses in binderies, and the laundry cuff press, is especially harmful to women.

In order to push or carry a heavy weight it is necessary to forcibly inflate the lungs and rigidly fix the diaphragm. This increases interabdominal tension, and will eventually lead to prolapsus, anteversion, anteflexion, retroversion, or retroflexion of the uterus. The fatigue consequent upon continuous heavy muscular effort causes a relaxation of the ligaments which support the uterus, and, as the organ is situated in the pelvis with the heavy end up, when the ligaments lack tone, the force of gravity tends toward misplacement. Normally the uterus is well balanced by the round and the broad ligaments on each side, the sacro-uterine behind, and the vesico-uterine ligaments in front, and is to some extent supported by the vagina.

According to the investigation of Elizabeth Beardsley Butler, in Pittsburgh, in 1907–8, prolonged standing as customary in most departments of cracker factories, laundries, dyeing and cleaning establishments, metal works, lamp and glass factories, mirror, broom, cork, paper box, soap, and trunk factories, in some pressrooms, and in most mercantile houses. This standing for long hours may tend toward uterine misplacements, as indicated above. Then, too, the fatigue of the nerves of the back bears directly upon the uterine nerve supply, which is derived from the second, third, and fourth sacro-spinal nerves, and from branches of the hypogastric (sympethetic) plexus, this not only causes local but reflex symptoms which impair the functions of other parts of the body. The numerous occupations which, on the other hand, require the employee to be seated for hours in one position have an especially deleterious effect upon a woman's health by tending to overfull bladder, constipation, and pelvic congestion. The uterus is placed between the bladder and the lower end of the large intestine which passes above and back of the uterus, and the straining caused by difficult defecation produces at least 50 per cent of downward misplacement of the uterus, with all its attendant discomfort, and the frequent necessity of spending several weeks in a hospital. Constant overloading of the rectum causes pressure on many of the 28 blood vessels in the pelvis and interferes with the return of venous blood, thereby causing congestion and possible inflammation of the ovaries, Fallopian tubes, uterus, and vagina, which means ofttimes invalidism, sterility, habitual miscarriages, or lifelong misery.

Dr. Ely Van der Warker has called attention to the fact that the shape of the knee, the shallowness of the pelvis, and the delicate construction of the foot of a woman render her inadequate for continuous standing for 8 or 10 hours. He calls attention to the "smallness of the patella and the narrowness of the articular surfaces of the tibia and femur. The lateral prominences of both bones are more developed in man, and therefore his knee joint helps to form a more perfect sustaining column. In a woman the muscles which keep the body fixed upon the thighs in the erect position labor under the disadvantage of shortness of purchase owing to the short distance, compared to that of a man, between the crest of the ilium and the greater trochanter of the femur, thus giving to men a much larger purchase in the leverage existing between the trunk and the extremities; and, comparatively, the woman's foot is less able to sustain weight than the man's, owing to its shortness and the more delicate formation of the tarsal and metatarsal bones." It must, however, be borne in mind that this is somewhat offset by the fact that the average weight of a woman's body is less than the average weight of a man's, and that the feet of European and American women have increased in size with their greater use.

One of the primary drawbacks for women in the industrial life of to-day is that most factories are equipped for the convenience of men workers. Mrs. Florence Kelly called my attention to the use in one instance of tables designed for men to sit at them, and used by girls 14 years old, who are thus quite needlessly obliged to stand.

Prolonged standing and excessive use of the legs, as in the manipulation of the treadle machines, has an effect upon the bones of the pelvis, particularly in poorly nourished women between the ages of 14 and 25, as the bones are then not sufficiently hard to resist the mechanical effects of the extreme pressure. The pelvis forms a bony girdle which supports the weight of the rest of the body and is itself supported by the legs, the heads of the femurs fitting into the acetabuli, the concave sockets on each side of the pelvis. Constant standing causes this pressure to symmetrically narrow the pelvis. The incessant use of one limb may cause a lateral deformity which will render difficult or impossible an erect position of the body, upon which depends to a large extent the health of every organ, because unless the lungs have sufficient room to expand they can not aerate the blood, and therefore a large portion of the waste products of the body is not eliminated, and oxygen is not supplied to the tissues of the body. All occupations which cause the workers to become round-shouldered are fundamentally injurious, because the space for each organ in the body is so apportioned that the encroachment of one organ, or set of organs, upon others (as from faulty position of the bony structure) interferes with the function of the organ pressed upon. The especial menace of any pelvic deformity is in its relation to pregnancy. Any narrowing of the pelvis interferes with development of the child in utero and may necessitate an instrumental delivery, with the attendant risk of serious injury to both mother and child.

The health and vitality of the child from the time of conception depend very much upon the mother's physical condition; an unhealthy condition of her tissues may prevent a proper development and implantation of the placenta. A large number of miscarriages are due to this cause, and later, if she is overworked and poorly nourished, the nourishment of the child will be very much interfered with during gestation and lactation.

In a symposium on sex problems in relation to the health of working women it would not be right to omit mention of two very important factors which greatly reduce their health ratio, although these diseases are not due to industrial strain, and indeed the women themselves are often ignorant of having acquired them. Their working efficiency is frequently reduced as a result of their suffering from syphilis and gonorrhea, and the economic effect of this is far-reaching. The placenta, under ordinary circumstances, acts as a filter and prevents the transmission of disease; for instance, a child of a tubercular mother is not born with tuberculosis, but a child may inherit syphilis from its mother or father. Unfortunately, a large number of working women suffer from syphilis and gonorrhea, of the presence of which they are ignorant, and for which they therefore do not seek diagnosis and treatment.

In connection with the physical efficiency of women a study of women athletes was made in 1884 by Dr. Sarah E. Post, and one recently made by Dr. Angenette Parry is interesting. She found that a bareback rider, 35 years old, who while performing jumps through a hoop at the rate of six times a minute, in one pregnancy rode until the eighth month, and a normal child weighing 9 pounds was born at term. In another pregnancy she also rode until the eighth month, and began riding again four weeks after the birth of this her fourth child. The woman is in perfect physical condition.

Another rider continued to ride until the eighth month, and later nursed her child. These women, when asked whether they were exceptional cases, said no one ever heard of anyone breaking down in the business. Another, who was also the mother of a rider, had six children living. A trapeze performer, 25 years old, has regular menstruation and no pain. The flow stops while she is performing.

A hippodrome acrobat; tumbler; hand balancer; 27 years old; began training at 5 years; trapeze and rings; first menstruation at 12; always regular; 5 days; moderate flow; no nausea or vomiting; no cramps; occasional headache; flow does not stop while performing. Married at 20; first pregnancy; performed until fifth month; very easy labor—12 hours; second pregnancy, very easy labor—half an hour; after three months went back to the stage; plenty of milk.

Mrs. Hosfall; father an American, mother an Indian; educated by missionaries in summer; the rest of the year followed the band of Indians; married at 20; trapped with husband; poles, tracks boat, handles ax, builds cabin, shoots, hunts, cooks; skillful in Indian woman's practical work, dressing animals, tanning, and so forth. Four healthy daughters in five years; two youngest each born on the bank of the river, with the temperature many degrees below zero, where she was entirely alone and must keep fire and cook; passed successfully through it all.

Dr. Parry pointed out that these women wore no heavy skirts; that their training began in childhood; and that they undoubtedly have unusually strong uterine ligaments; they are very careful of personal hygiene and have plenty of air, wholesome food, and work which they enjoy. A young woman recently swam across San Francisco Harbor, a distance of 8 miles, and on arrival was not fatigued. The feat had been accomplished but twice before. These are exceptional cases and not especially to be recommended, for in both men and women an overtaxed dilated heart often results in fatty degeneration of the heart and muscles and generally follows a discontinuance of vigorous athletics. Moderate regular exercise is necessary for continued good health, and the normal woman can attend to her ordinary duties during her menstrual period without injury, although on account of the uterus being physiologically heavy at that time, overexercise and vigorous exercise should be avoided the first three days of the period.

Much has been said and written about nervous strain in women's work, and there are some occupations, especially that of telephone operators (as pointed out in the investigation of telephone companies, in Senate document 380), which call the special senses into play in a manner in which they are required to act not only continually but concertedly. This feature calls for special consideration in estimating the strain to which telephone operators are subjected by the nature of their work. As has been pointed out, connections on a switchboard are made by inserting a small plug in a small hole above which the number of the telephone requested appears. The eye is attracted in the first instance by the glowing of a light which announces the call. It has then to immediately find on the switchboard the hole in which it is necessary to insert the plug to make the desired connection. Similarly in disconnecting, the eye detects the extinction of the light, and then seeks on the switchboard the number with which the connection has been made. This means constant employment of the muscles of the eye in different directions and constant use of the optic nerve. The ear, in receiving calls, is required to distinguish between a multitude of different voices to ascertain at once, in order to avoid repetition, the number asked for, no matter how indistinctly or ill pronounced the number may be. This necessitates constant alertness of the auditory nerve, while the vocal organs are scarcely less constantly in use in the answer of calls, the repetition of numbers, and the conduct of such conversations as may be necessary. The sensations created by the operation of the several senses in this manner transmit their several messages to the brain, which, in turn, directs and governs the actions they suggest.

These special senses are simultaneously called into play also in stenography, typewriting, and telegraphy, but to a less extent than in telephone operating. These forms of work are psychologically and physically well adapted to women, but hours of employment should be shorter than in other forms of work which are less expert and taxing to the nervous system. The report of the Royal Commission of Canada on telephone companies presents a study of special value.

The increase of nervous prostration among both men and women is perhaps the most important effect of strain which we have to consider, for all muscular and intellectual effort requires the expenditure of nervous energy, and overlong working hours wholly exhaust the sources of nerve endurance. Nerve cells are the producers of energy, and nerve fibers conduct this to the muscles. Stimulation is wholesome; overstimulation produces accumulations of waste products, which act as a definite poison, and demonstrable changes take place in the cells of the brain and spinal cord. Miss Josephine Goldmark has compiled much valuable data in her book on "Fatigue and Efficiency," which forms an unanswerable argument for shorter hours of work for both women and men.

The measure of pleasure one finds in work markedly affects the amount of strain, as is well illustrated by the fact that work which well accomplishes its object is less fatiguing than the same amount of energy spent on work in which one is not interested or which results in failure. The training of women in salesmanship by Mrs. Lucinda W. Prince in the Woman's Educational and Industrial Union, in Boston, shows the value of so educating woman that her brain and physical force may work together, giving her a sense of responsibility in regarding her work as a vocation, with intelligent interest in system, attention to details, increased knowledge of the goods to be sold, color, design, textiles, and so forth. Pupils sent from five well-known Boston department stores receive full wages while taking the three months' course, which occupies them each morning. The value of this as a business proposition, as well as an illustration of the increase in efficiency with the lessening of strain, is shown by the fact that their afternoon sales give them a weekly total as high as the employees who do not attend the school and who work all day.

In summarizing the direct effects of industrial strain on the working woman, it is my opinion, after consulting statistics compiled by many investigators, boards, institutions, companies, colleges, and others, and also after conferring with a number of thoughtful people who have opportunities to observe women who work under varied conditions, that, with properly regulated hours of work and recreation, outside of the excessive physical labor to which I have referred in this paper, women may work in practically any field of modern industry, and not only retain but increase their standard of health. But they must be given hygienic and properly arranged buildings in which to work and they and their employers taught the common sense of the laws of health. This education is the great need. For when legislatures and their constituents really comprehend that the health of its citizens is the greatest asset of any nation, they must pass laws protecting the health of laborers, and this will occur when a greater number of their constituents are interested in the health of women of all classes.

Without education, good laws may be inactive. For instance, in six States—Massachusetts, Maryland, California, Wisconsin, Illinois, and New York—we have laws providing seats behind the counter for saleswomen, which, however, they are prevented from using by the disapproving watchfulness of a floorwalker who is ignorant of the relation of fatigue to inefficiency.

When individuals are educated to understand that their happiness and continued usefulness depend upon personal as well as industrial hygiene, there will be a fullness of joy in living which is a perfectly practical standard for the attainment of which the world's best citizens are working.

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[1] See appended list of references.

INFANT MORTALITY IN RELATION TO FACTORY LABOR.

George Reid, M. D., D. P. H., county medical officer, Staffordshire, England.

Among the contributory causes of excessive infantile mortality it is difficult to assign to each its relative share in the sum total. It has been conclusively proved, however, that to improper feeding, the result of ignorance, poverty, or adverse domestic circumstances, must be given a prominent place among the factors, and it follows that causes which tend to increase the number of artificially fed infants in a community must increase the rate of mortality, unless the causes in question incidentally improve the chances of survival in other respects, and so wipe out the effect of the added risk attributable to improper feeding.

Applying this argument to artisan communities similarly circumstanced as regards domestic and hygienic conditions generally, but differing in respect of the facilities which the trade of the district affords for women employment, which takes mothers away from their homes in the daytime, and thus adds to the proportion of artificially fed infants, one would expect to find that the infantile mortality in the latter group would exceed that in the former. It so happens that in Staffordshire we have large artisan populations, all equally favorably situated as regards domestic circumstances and not differing in their hygienic surroundings, but presenting a wide difference in the facilities afforded for the employment of women in factories and works.

Broadly speaking, the artisan towns of Staffordshire are grouped together and constitute two large populous centers in the extreme north and south of the county. In the northern group, embracing the pottery towns, many married women are employed in factories, whereas in the southern group, where the artisan classes are engaged mostly in iron works and collieries, such employment is less common. When I first was connected with the public-health work of the county, year by year, as the mortality returns reached me, I was struck by the greatly increased infantile mortality figures in the northern as compared with the southern towns, and, as I was unable to attribute this to differing circumstances as regards prosperity of the populations or their hygienic surroundings, I determined to classify the towns more strictly in accordance with the proportion of married women employed in factory work, disregarding their geographical position, and so make more acutely obvious the effect of such employment on the infantile mortality, supposing that to be the chief factor in operation in the towns in question. To enable this to be done the registrar general was good enough to supply me with the needful data, and in the following table figures are given showing the infantile mortality for three decennial periods in the artisan towns in question, irrespective of position, but grouped according to the number of married and widowed working females in relation to female population between 18 and 50 years as disclosed by the 1901 census.

Had it been possible to work out the rates in each case on the married female population only, the percentages would of course have been higher, but I had no data to allow of this being done. Again, I was obliged to assume, in the absence of corresponding figures from previous census returns, that the number of married and widowed outworkers to the female population within the specified age limit was the same throughout the 30 years covered by the infantile mortality figures, as in 1901, an assumption which, I think, is justified by the fact that no change has taken place in the special trades carried on in the various towns during the whole period.

Class according to percentage of married and widowed workers to female population between 18 and 50 years.	Number of towns.	Total population, 1901 census.	Deaths of infants under 1 year per 1,000 registered births.		
			1881–1890	1891–1900	1901–1909
I. 12 per cent and over	5	132,299	195	212	18
II. Under 12 per cent and over 6 per cent	13	263,868	165	175	152
III. Under 6 per cent	8	131,508	156	168	139

It will be seen from these figures that, while the mean rate for the last period has been considerably lower in each group than in the previous two decennial periods, practically the same relative proportion has been maintained in the three groups.

At the request of the Home Office I recently conducted a special inquiry into the effect on infant mortality of the employment of married women in factories.

The inquiry was confined to the six pottery towns—namely, Hanley, Stoke-upon-Trent, Tunstall, Burslem, Longton, and Fenton—the object being to determine with greater accuracy than had been possible hitherto the effect of home conditions, and especially the influence of factory employment, upon infant mortality. With this object in view particulars regarding the 12 months' history of infants born among artisan families in 1908 were noted, the information being obtained by four experienced ladies who were specially appointed for the purpose and who from day to day, for a period of about five months, visited the families to obtain answers to a comprehensive schedule of questions. We thus succeeded in obtaining the desired particulars relating to 4,275 infants born in the year in question, and from the schedules summary sheets were prepared on a prearranged plan for the convenience of the Home Office officials.

In the following table the figures of infantile mortality in the two groups of families are shown:

Class.	Number of births in 1908.	Deaths under 1 year.	Deaths under one year per 1,000 births.
Home mothers	3,150	462	146
Mothers working in factories or away from home during the day	1,125	236	209

It will thus be seen that the death rate among infants of mothers who leave their homes during the day to engage in work in factories or elsewhere exceeds that among infants of home mothers by 43 per cent. I have always contended that this result is attributable to the fact that among the home-mother class a larger proportion of the infants are naturally fed and thus have a better chance of survival than the infants of the other class, most of whom are artificially fed.

Hitherto I have not been able to obtain reliable data showing the relative death rate among breast-fed and artificially fed infants in Staffordshire, but, thanks to the Home Office inquiry, figures relating to artisan families in the six pottery towns are now available, from which I have prepared the following table. For the purpose of this table I have selected those infants only who were alive one month after birth, because, contrary to my expectation, practically all the factory mothers suckled their infants during the four weeks they were compelled by law to remain at home after their confinements, while most of the other outworking mothers were at home for at least two or three weeks after their confinements. For the purpose of grouping, as regards feeding, I have included among the wholly breast fed only those infants who were so fed for three months and upwards:

Incidence of mortality among infants who survived the first month of life, classified according to nature of food.

	Breast wholly.	Breast partly.	Artificially wholly.
Number surviving first month	2,429	932	457
Number of those dying under one year	235	162	114
Deaths under one year per 1,000 infants who survived first month	97	174	249
Percentage increase over breast fed	....	79	157

I am aware that in certain large towns—Birmingham, for example, where similar inquiries have been conducted—the fact of mothers working in factories does not seem to increase the infant death rate, and the suggested explanation is probably the right one—namely, that the increased earnings from such work enable the families in question to live under better home conditions as regards food, clothing, and so forth, and by counteracting the injurious effect of poverty, balance the injury arising from the increased porportion of artificially fed infants. Among the families in the pottery towns included in the inquiry, however, poverty was conspicuously absent, and the standard as regards home conditions was remarkably uniform, so that the evil effect of injudicious artificial feeding was not obscured by other compensating influences.

Dr. Robertson, the medical officer of health of Birmingham, in commenting upon the fact that the result of the inquiry in that town did not show that the employment of married women away from home had an adverse influence on the infantile mortality, pointed out that all the families embraced in the inquiry belonged to the very poor class, and that in all probability the money earned by the working mothers provided the means of relatively improved living, and thus counteracted the effect which otherwise might have been produced by the deprivation of mother's milk. As I have stated, the inquiry I conducted in Staffordshire was confined to well-to-do artisan families, and the mothers who engaged in factory work did so from inclination, not necessity.

The Home Office inquiry was a very comprehensive one and the facts ascertained had reference to all influences bearing upon infantile mortality in relation to factory labor. In the pottery towns of Staffordshire, for example, it embraced the effect on the miscarriage and stillbirth rates of working in lead, and from the returns I have compiled the following table, in which the rates have been corrected for period of married life, the mean period being 8.9 years:

	Number of records.	Percentage of mothers having—			Number per 100 mothers.		
		Miscarriages.	Stillbirths.	Miscarriages and stillbirths.	Miscarriages.	Stillbirths.	Miscarriages and stillbirths.
Housework	2,812	16.0	10.6	24.0	27.2	14.8	43.2
Factory and other workers (not in lead)	984	9.2	8.4	16.4	26.6	21.0	47.6
Mother:							
Lead worker previous to marriage	121	25.6	6.6	30.6	74.2	11.8	86.0
Lead worker since marriage.	70	30.0	14.3	37.1	99.0	32.8	133.5
Father: Lead worker	148	16.9	7.4	22.9	35.5	11.8	48.0

It is to be regretted that the figures relating to lead workers are relatively so small, but no selection of families was made; and it so happens that among those inquired into as having had children born during 1908 only the number stated chanced to be lead workers. Small though the numbers are, however, they are very significant; and I do not think that the suggestion they convey, that mothers who work in lead are three times more liable to have miscarriages and stillbirths than other mothers, can be entirely discredited because of possible statistical error. Granting that the figures may be relied upon, it would appear that working in lead before marriage, although not afterwards, also conduces in lesser degree to an increased miscarriage and stillbirth rate.

INFANT MORTALITY IN RELATION TO FACTORY LABOR.

JOHN ROBERTSON, M. D., B. Sc., medical officer of health, Birmingham, England.

It is probable that all will agree that the child of a mother who is engaged in factory labor, both before and after her confinement, does not, and never can have, as good a chance of survival as that of the mother who can, during pregnancy and lactation, do what she wishes for herself and her infant. The experience of every country is that among the poorer classes those children who are breast fed have a better chance of survival than those who are artificially fed. Statistics amply justify this everywhere. It is indeed inconceivable that the home of the mother who has to work in a factory for many hours daily can be as well cared for as that of the mother whose whole energy, time, and interest are spent on it.

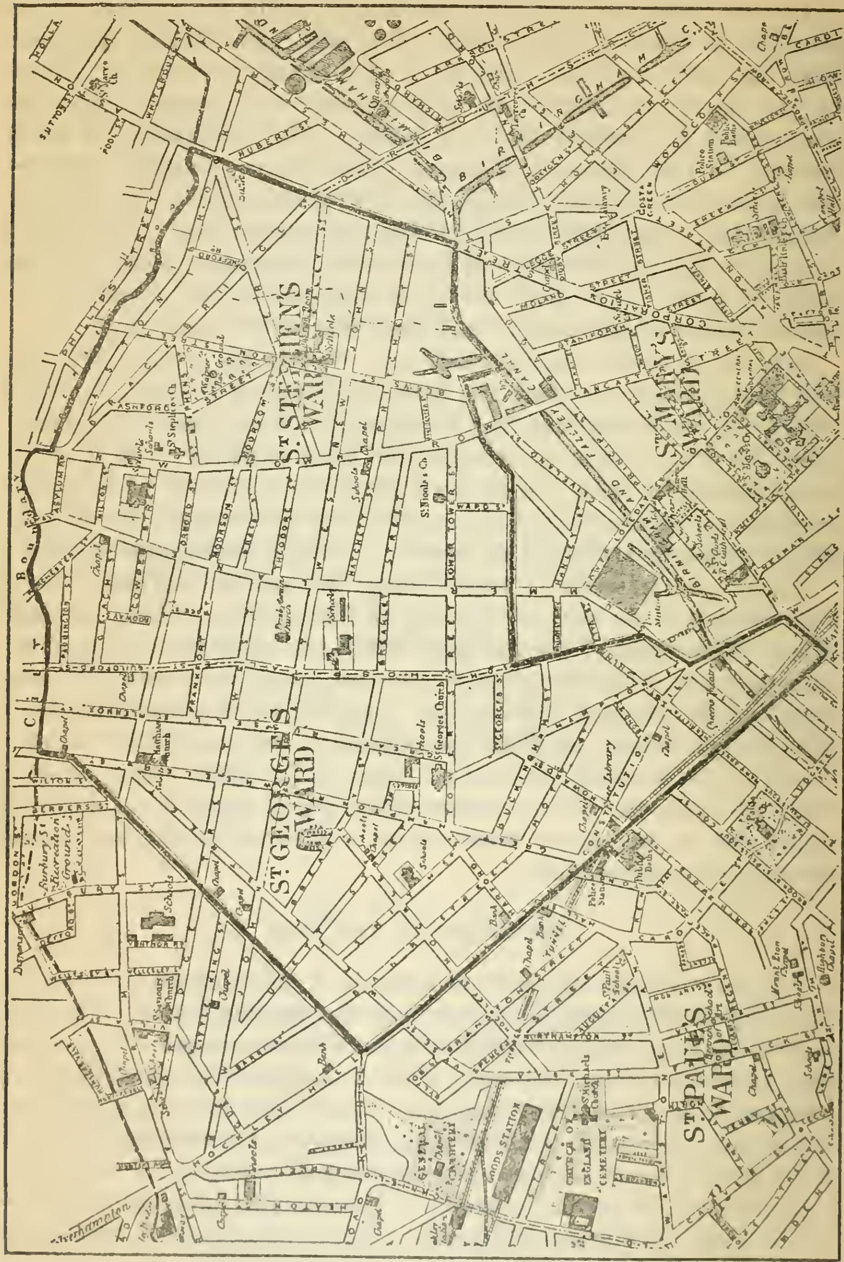
The real question resolves itself into whether the mother who goes out to the factory because the household income is small, is doing something which enables that household to keep above the poverty line. In other words, is it better for these mothers to go to work, notwithstanding some damage to the infants, or to stay at home and receive the damage done by poverty? Does factory labor do as much harm to mother and child as poverty? Which is the greater evil?

To test this question, I would bring forward the statistics I have accumulated in an area of the city of Birmingham, where approximately 50 per cent of the married women are employed during child-bearing years, while the other 50 per cent are of very much the same class, but do not work in factories. In so far as these statistics relate to a district where the whole population is what might be called a "very poor working class one," they differ from those relating to areas where the poorer women alone go to work, while many of those who do not go to work are of a different social status, and therefore not comparable.

DESCRIPTION OF THE AREA.

All the mothers and infants lived in a well-defined area in the poorest part of Birmingham, shown on the appended map. The area is peopled largely by unskilled artisans with low wages. The dwellings consist of small cottages, often rather crowded together, and varying from 60 to 100 years old. In the area are many factories and workshops, most of these being engaged in the manufacture of light metal fittings, such as brass work, cycle parts, and such like.

The area is 289 acres in extent. The estimated population in 1908 was 41,884. The mean death rate was 22.5 per thousand, while that for the whole city is under 15 per thousand. The infantile mortality rate has varied from 150 to 232 per thousand infants born. The



density of population per acre in St. Stephens ward was 132.7, and in St. Georges was 162.1.

The percentage of married women employed is approximately 53 per cent. In the whole city of Birmingham it is 19 per cent. For such an investigation as the present the district is an excellent one.

HOW THE OBSERVATIONS WERE MADE.

Dr. Jessie Duncan, with two lady health visitors, were appointed by the health committee of Birmingham to carry out, under my direction, an inquiry on the influence of employment on the mother and her infant. They have dealt with every birth occurring in the area and those occurring in institutions coming from this area.

Weekly or monthly visits were made to the homes after the birth of a child, and frequent weighings of the infants were made in most cases.

During the four years, 1908 to 1911, inclusive, 5,993 infants were born. Of these, 5,898 were legitimate, i. e., the rate of illegitimacy was 15.9 per thousand, an exceptionally low rate.

Of the 5,993 confinements, 1,182 were attended by a medical practitioner, 4,357 were attended by a midwife, and 454 were confined in institutions or were unattended.

Of the 5,993 births, 159 were stillborn, and 250 died within one month of birth.

Only 137 infants were born in homes which were of a class distinctly better (shopkeepers, and the like), so that the 5,856 infants and mothers dealt with in this paper were, from their home circumstances and surroundings, strictly comparable.

Employment and premature birth.

	Mothers.	Premature births.	Rate per thousand.
Mothers employed before confinement	2,966	156	52
Mothers not employed before confinement	3,255	125	38

Factory labor, then, has a distinct influence in causing premature birth.

Morality among infants under one year per thousand births.

	Infant mortality rate.		
	1908	1909	1910
Mothers employed in factory	186	194	168
Mothers employed elsewhere	200	147	123
Total employed	190	179	153
Total not employed	207	169	161

It will be noticed that in 1908 and 1910 the rate of infant mortality was greater among women not employed than among employed.

Of the infants kept under observation one observer recorded her opinion as to the health of the child at 12 months of age, and the results are as follows:

	Condition of infant at 12 months.					
	Good health.		Fair health.		Poor health.	
	1909	1910	1909	1910	1909	1910
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Mothers employed	57	59	28	29	15	12
Mothers not employed	63	69	24	23	13	8

This shows that a larger percentage of infants of mothers not employed than of those of mothers employed were at the end of 12 months in good health.

The balance is distinctly in favor of the unemployed mothers' infants.

The employment of mothers was so varied that no useful classification could be made which would enable us to arrive at the influence of hard, as distinguished from light, work in the production of unwholesome conditions.

The women who worked in factories were largely employed in power-press or hand-press work, polishing metals, and grinding light articles.

AGE OF MOTHER IN EMPLOYMENT.

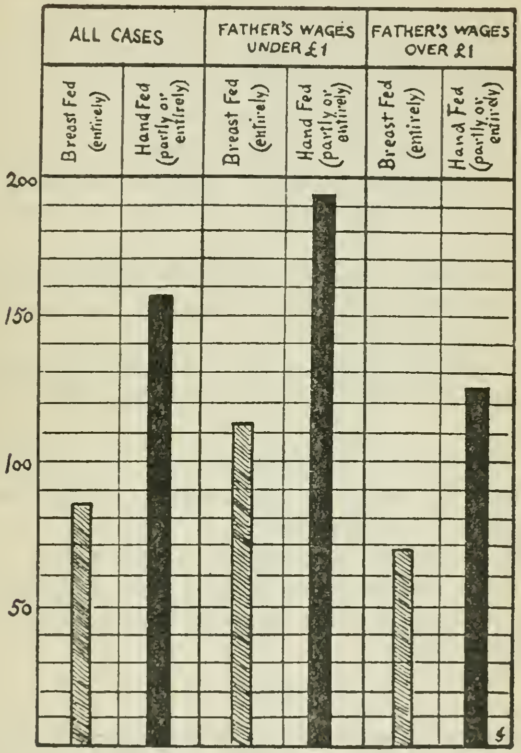
A large number of employed mothers were under 30 with small families, apparently indicating that when the family is large the mother is unable to leave home. This fact has a considerable influence on the statistics of death and ill health. We have found that the mortality among infants of young mothers, whether employed or unemployed, is greater than among those of older mothers.

Poverty has a greater influence on the infant than factory labor.

	Father out of work or earning less than £1 per week.		Father earning £1 per week or over.	
	Infantile mortality rate.		Infantile mortality rate.	
	1910	1909	1910	1909
Mother employed in factory	203	235	123	146
Employed at home or elsewhere	187	176	53	120
Total employed	198	217	99	137
Not employed	191	199	150	154
Total	196	211	127	146

This shows that the mortality is 50 per cent more in the case of mothers in poverty than in those not in poverty.

In the following diagram the great influence of poverty is shown, as well as the influence of artificial feeding in producing infant mortality:



INFANT MORTALITY IN RELATION TO FEEDING AND POVERTY.

Employment of mother and weight of infant at 12 months.

	Father out of work or earning less than £1.		Father earning £1 or more.	
	1910	1909	1910	1909
Mother employed in a factory	17¾	17½	18½	18¼
Employed at home or elsewhere	17½	17¾	18¾	18¼
Employed	17¼	17½	18½	18¼
Not employed	18	17½	19	18½

It will be noted from this table and from the charts that both employment and poverty influence the weight of the infant at 12 months, but of these poverty is overwhelmingly the greater influence.

The nutritive value of the human milk given to infants was carefully estimated, both in women above and below the poverty line, and in those employed and not employed.

Numerous samples were obtained from each mother, and on these the following observations are based:

It was soon evident that factors over which there was apparently no control influenced the amount and quality of the milk.

The whole of the milk contained in one breast was drawn off and a portion taken to the city analyst for analysis. Careful note was made as to the time since the last emptying of the breast.

By means of a breast pump it was not possible to get out as much as the infant was proved to get by careful weighing before and after its meal. The amount varied in 136 observations from 7 to 147 cubic centimeters.

The amount increased with the period of lactation from an average of 49.7 cubic centimeters during the first month to 114.6 cubic centimeters at 9 to 12 months.

The average quantity obtained was 34 cubic centimeters after a two hours' interval and 48.5 cubic centimeters after a five or six hours' interval.

The proteid varied from 0.7 to 1.9 per cent, lactose from 6.6 to 7.6 per cent, ash from 0.2 to 0.3 per cent, solids not fat from 7.7 to 9.3 per cent, fat from 0.7 to 5.7 per cent.

None of these variations appeared to be dependent either on the employment of the mother or on her poverty. Indeed, some of the rich milks were obtained from mothers who were obviously in a condition of starvation.

CONCLUSIONS.

In the special area under review there appears to be no doubt about the prejudicial influence of employment of pregnant and nursing mothers in factories, both on their infants and on themselves.

Poverty has, however, a much more deleterious influence; and if by employment poverty can be removed or lessened, such employment is the lesser by far of two evils.

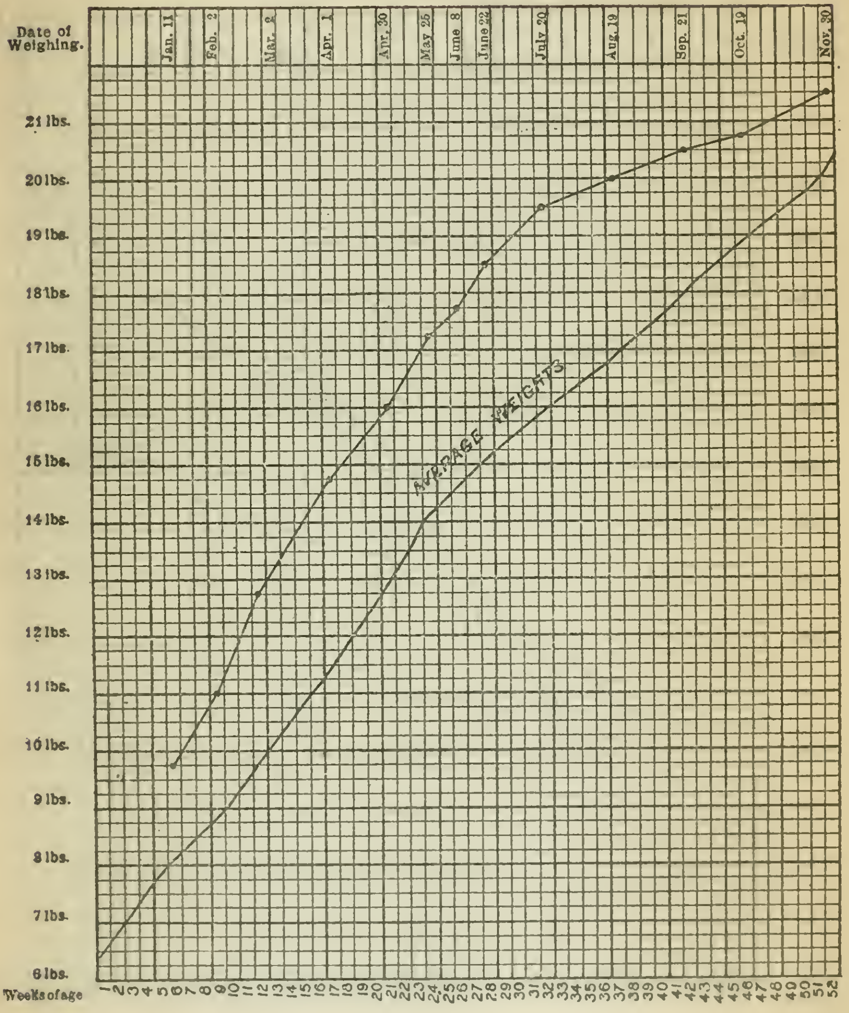
Inspection of the homes of women who have to be at factories all day clearly indicates that the removal of the mother gives rise to many conditions of dirtiness or irregular or bad nourishment of infants, which must obviously be prejudicial. It is perhaps fair to many of these women to record how well they carry on their home duties under the very difficult circumstances in which they are placed. Many breast-feed their infants at the factories and keep their homes extremely clean.

NO POVERTY.

(D11806)

Name, B M. Date of Birth, Aug. 18th, 1908.

Method of Feeding, Breast only.

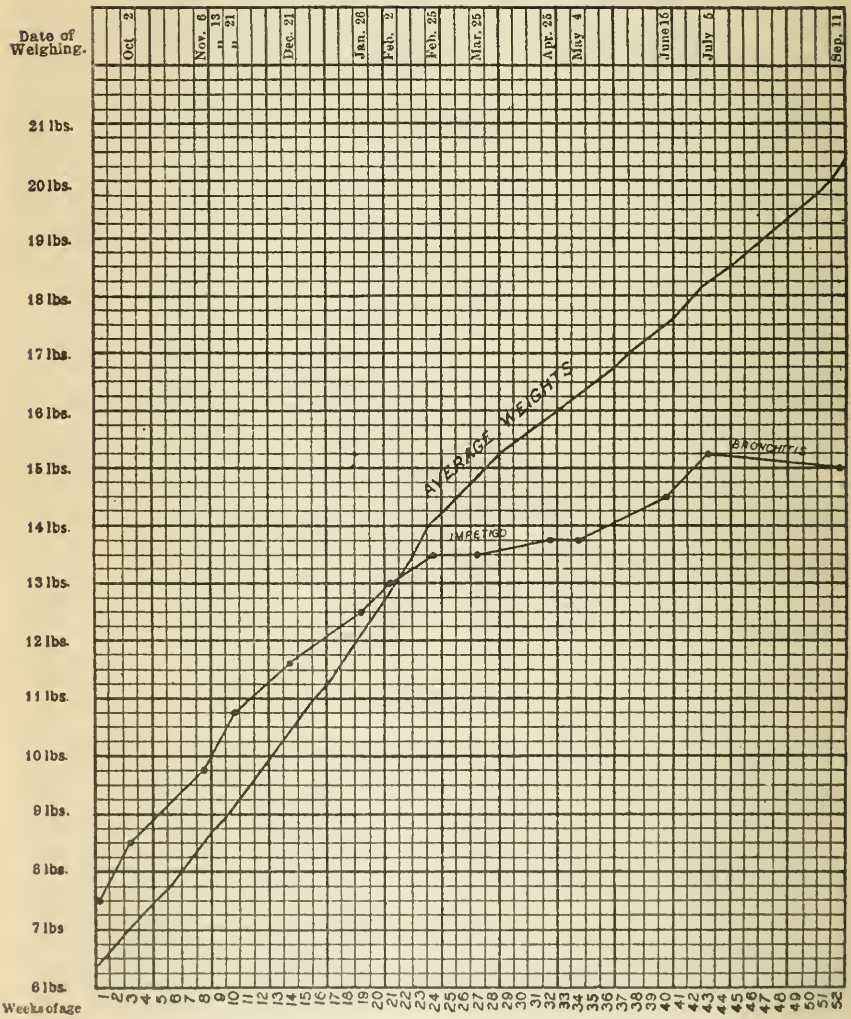


POVERTY.

(D11806)

Name, H C. Date of Birth, Sept. 11th, 1908.

Method of Feeding, Breast only.

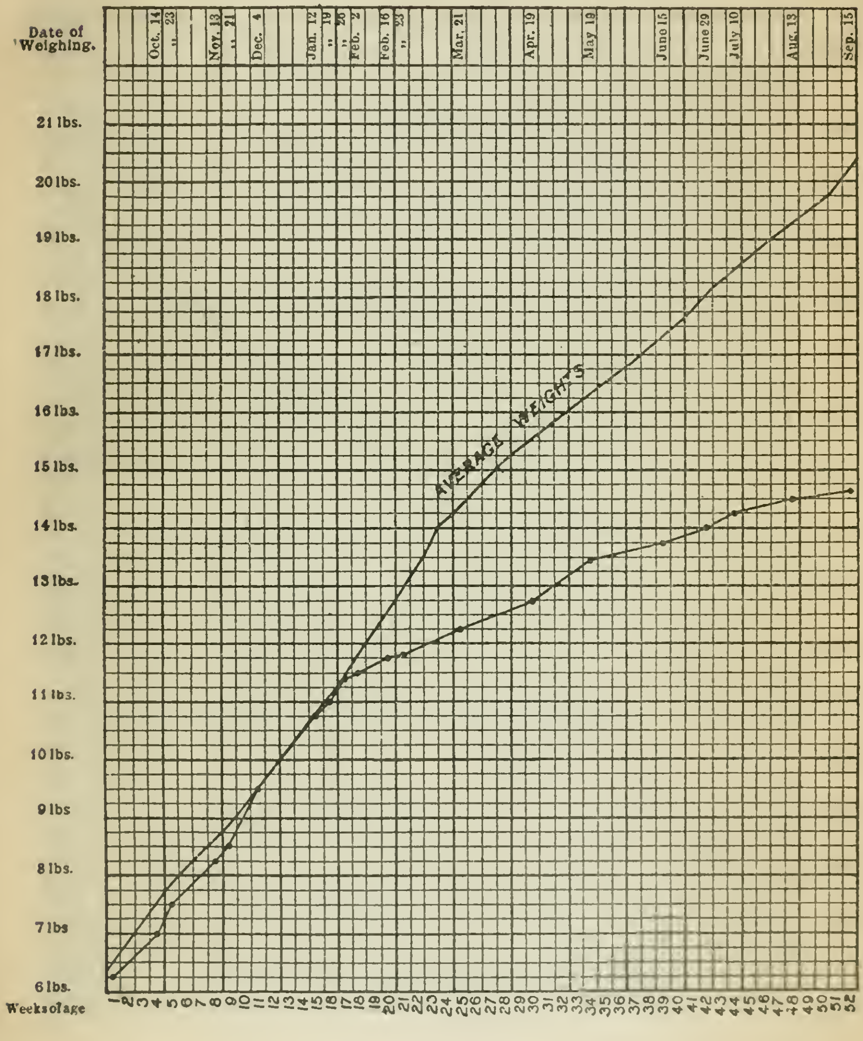


POVERTY

(D11806)

Name, E. B. Date of Birth, Sept. 14tn, 1908.

Method of Feeding, Breast only.

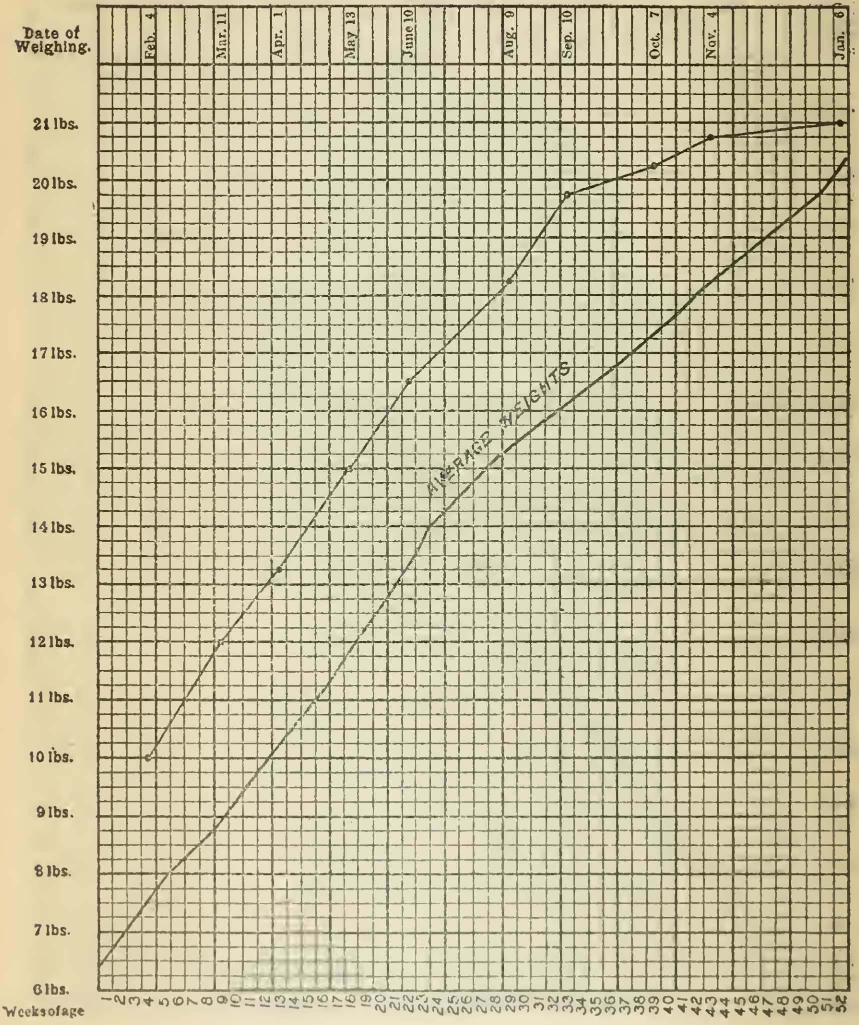


NO POVERTY

(D11806)

Name, C. F. Date of Birth, Jan. 6th, 1909.

Method of Feeding, Breast only.



ALTERSPROBLEME GEWERBLICHER HYGIENE.

Dr. Ludwig Teleky, Privatdozent, Wien, Austria.

Elend und Armut hat es auch schon in älteren Zeiten gegeben, aber eine Art von Unterdrückung und Elend muss—wie Held in seinen "Zwei Bücher zur sozialen Geschichte Englands" ausführt—als ein durchaus eigentümliches Produkt der modernen Grossindustrie bezeichnet werden, nämlich die Ausbeutung der Kinder unter Auflösung der Familienbande und gänzlichen Mangel an Rücksicht auf die Heranziehung einer gesunden kräftigen Generation.

Dieses letztere Moment war es, das schon frühzeitig die Aufmerksamkeit von Aerzten und Militärs auf die schädlichen Folgen der Beschäftigung von Kindern in Fabriken lenkte.

In Oesterreich wurden bereits unter dem 20. XI. 1787 "Zur Beseitigung der bemerkten Gebrechen bei der physischen Erziehung der Fabrikslehrlinge" die ersten Anordnungen für den Schutz der kindlichen Arbeit erlassen, denen unter dem 12. III. 1816 weitere Bestimmungen folgten, die den städtischen und den Bezirksärzten eine genaue Aufsicht und Untersuchung der körperlichen Pflege der Kinder in den Fabriken zur Pflicht machten, "da bei Fabriken die Gefahr der Verkrüppelung und Verwahrlosung doppelt gross ist." In England war es Dr. Percival vom Manchester Board of Health, der 1796 auf die Schädlichkeiten der Kinderarbeit hinwies; 1802 wurde das erste englische Arbeiterschutzgesetz erlassen, das sich fast ausschliesslich mit der Kinderarbeit in Fabriken beschäftigte. In Preussen wurde, vor allem Dank einem "Landwehrgeschäftsberichte" des Generallieutenants von Horn 1839 ein "Regulativ über die Beschäftigung jugendlicher Arbeiter in Fabriken" erlassen.

So steht überall der Kinderschutz am Uranfang aller Arbeiterschutzbestrebungen, und Sorge um Gesundheit und Kraft der heranwachsenden Generation, deren Entwicklung durch die Fabriksarbeit schwer geschädigt wird, ist der Beweggrund dieser ersten Schutzgesetze.

Jeder wachsende Organismus, jeder Organismus, der noch an seinem eigenen Aufbau arbeitet, ist besonders empfindlich gegen äussere Schädigung, gegen zu geringe Einnahmen (unzureichende Nahrung), zu grosse Ausgaben (übermässige Arbeitsleistung). Allen Tierzüchtern ist es bekannt, dass diese Schädigungen nicht nur zu quantitativen, sondern auch zu qualitativen Unterschieden (Verunstaltungen) führen.

Der kindliche Organismus hat einen lebhafteren Stoffwechsel als der erwachsene, die CO_2 Abgabe, die bei annähernd gleichartiger Ernährung als relatives Mass des Stoffwechsels gelten kann, ist (nach Tigerstedt und Sondén):

Mittleres Alter in Jahren, männliches Geschlecht.	CO_2 pro Stunde und Kilogramm.	CO_2 pro Stunde und m^2 Körperoberfläche.
	g.	*g.*
7.86	1.149	26.27
9.59	1.207	29.86
10.53	1.106	28.22
11.39	1.063	27.54
14.54	.960	26.65
19.51	.718	21.81
25	.569	18.48

Die 24stündige Zufuhr von Nahrungsmitteln ist beim Kinde (relativ) grösser als beim Erwachsenen. Sie beträgt nach Cammerer:

Alter: Jahre männliches Geschlecht.	Kalorien pro Kilogramm in 24 Stunden.	Kalorien pro m^2 Körperoberfläche in 24 Stunden.
5–6	76.7	1,680
7–10	61.7	1,440
11–14	47.4	1,250
15–16	39.8	1,220
17–18	37.7	1,200
Erwachsenen.	32.0	1,071

Bedingt ist diese grössere Nahrungsaufnahme durch das Bedürfnis des wachsenden Körpers einerseits, durch die Kleinheit des kindlichen Körpers und den dadurch veranlassten grösseren Wärmeverlust andererseits.

Machen schon diese Momente: Aufbau des eigenen Körpers, ungünstige Wärmeökonomie, das Kind empfänglicher für alle den normalen Stoffwechsel ungünstig beeinflussende Schädlichkeiten (Mangel an Bewegung, an frischer Luft, wie sie Fabriksarbeit meist mit sich bringt) und deshalb zur Arbeit wenig geeignet, so kommt hiezu noch der Umstand, dass bei der relativ leichten Beeinflussbarkeit der Wachstumsvorgänge die länger dauernde Belastung oder Ueberanstrengung einzelner Teile des Körpers zu Schädigungen derselben führt. Es sei hier nur als Beispiel auf die "Fabriksbeine," "Bäckerbeine" und die Rückgratsverkrümmungen sicilischer Carusi verwiesen, aber auch auf die Schulscoliose, die Schulkurzsichtigkeit.

Es darf uns deshalb nicht wunder nehmen, wenn nicht nur in jenen frühesten Zeiten barbarischester Kinderausnützung, wie sie für das erste Erwachen grossindustrieller Betriebsweise in fast allen Ländern charakteristisch war, über schwere Schädigung der Gesundheit der Kinder geklagt wird, sondern wenn uns über ähnliche krankmachende Wirkung von überall dort berichtet wird, wo Kinderarbeit auch heute noch besteht.

Im Kanton Appenzell A. Rh., wo die Kinder in der Textilindustrie (Fabriks- und Heimarbeit) stark beschäftigt werden, ergab die Recrutirung (nach Dr. Wiesmann, citirt nach Zinsli, "Kinderarbeit und Kinderschutz in der Schweiz," p. 68) folgende Resultate in Prozent der endgültig Untersuchten, an denen wohl zum Teil eben diese Kinderarbeit schuld ist.

Dienstbefreiungsgründe.	Appenzell A. Rh., 1893–1902.	Schweiz, 1893–1901.
	%	%
Zu geringe Korperlänge	57.2	23.7
Zu geringer Brustumfang	13.7	11.1
Schwächlichkeit, Anaemie	47.7	24.2
	118.6	59.0
Geistige Beschränktheit	14.0	8.7
Sehschwäche infolge Myopie	27.5	27.5
Sehfehler infolge anderer Refractionsfehler	45.1	19.7
Difformitäten der Wirbelsäule	9.6	8.8
Krankheiten des Herzens und der grossen Gefässe	20.2	12.9

Die vom K. K. arbeitsstatistischen Amt im Handelsministerium veranstalteten Erhebungen über die Kinderarbeit in Oesterreich ergaben, dass bei den in die Untersuchung ein bezogenen arbeitenden Schulkindern der Gesundheitszustand in 22.6 Prozent nicht befriedigend war und zwar bei den in der Landwirthschaft tätigen bei 17.3 Prozent, bei in der Industrie tätigen bei 29.6 Prozent, bei in mehreren Arbeitszweigen tätigen in 23.9 Prozent. Aber auch innerhalb der beiden letztgenannten Gruppen sind grosse Differenzen zu beobachten. Nicht befriedigend ist der Zustand bei Kindern, die tätig sind: in der Rohglaserzeugung (insgesamt 120) bei 50 Prozent, Erzeugung von Metallkapseln (insgesamt 241) in 46.5 Prozent, in der Textilindustrie bei 33.7 Prozent, Fransenknüpfen (insgesamt 273) 45.8 Prozent, Haarnetzerzeugung 42.7 Prozent.

Bei den in Industrie und Hauswirtschaft beschäftigten zeigen 33.5 Prozent nicht befriedigenden Gesundheitszustand, unter den im Haushalt und der Glasperlenerzeugung beschäftigten 70 in die Untersuchung einbezogenen Kinder 40, unter den im Haushalt und in der Bekleidungs-und Putzwarenindustrie beschäftigten Kindern (606) 38 Prozent. Leider fehlen als Vergleichsobjecte Angaben über den Gesundheitszustand nicht arbeitender Kinder.

Nebenbei sei noch bemerkt, dass nachteiliger Einfluss der Arbeit auf den Schulbesuch oder das Verhalten in der Schule festgestellt wurde bei 49.4 Prozent der arbeitenden Kinder, und zwar bei den in der Landwirtschaft tätigen bei 53.7 Prozent, bei den in der Industrie tätigen bei 46.7 Prozent, bei den in mehreren Arbeitszweigen tätigen bei 54 Prozent.

Berichten alle jene, die sich mit der Frage der Kinderarbeit in objectiver Weise und ernstlich beschäftigt haben, über die schwere Schädigung der Kinder durch die Erwerbsarbeit, so dass an dieser Tatsache selbst nicht im mindesten gezweifelt werden kann, so liegen doch exactere Messungen und Wägungen aus neuerer Zeit hierüber nicht vor. Erwähnenswert aber erscheinen Untersuchungen, die Corwell unter der armen Bevölkerung in Manchester und Stockport angestellt hat, und die Quetelet in seinem Werke "Ueber den Menschen und die Entwicklung seiner Fähigkeiten," 1835 (deutsch von A. Rieche, Stuttgart, 1838), citirt.

Mittlere Grösse und mittleres Gewicht der Kinder aus den unteren Volksklassen in Manchester und Stockport.

[Nach Quetelet.]

Alter in Jahren.	Knaben—		Mädchen—		Knaben—		Mädchen—	
	Die in Fabriken arbeiten.	Die nicht in Fabriken arbeiten.	Die in Fabriken arbeiten.	Die nicht in Fabriken arbeiten.	Die in Fabriken arbeiten.	Die nicht in Fabriken arbeiten.	Die in Fabriken arbeiten.	Die nicht in Fabriken arbeiten.
	Meter.	*Meter.*	*Meter.*	*Meter.*	*Kilogramm.*	*Kilogramm.*	*Kilogramm.*	*Kilogramm.*
9	1.222	1.233	1.218	1.230	23.47	24.15	23.18	22.87
10	1.270	1.286	1.260	1.254	25.84	27.33	24.85	24.68
11	1.302	1.296	1.299	1.323	28.04	....	27.06	27.72
12	1.355	1.345	1.364	1.363	29.91	30.49	29.96	29.96
13	1.383	1.396	1.413	1.399	32.69	34.17	33.21	32.97
14	1.437	1.440	1.467	1.479	34.95	35.67	37.82	37.83
15	1.515	1.474	1.486	1.502	40.06	39.37	39.84	42.44
16	1.565	1.605	1.521	1.475	44.43	50.01	43.62	....
17	1.592	1.627	1.535	1.542	47.36	53.41	45.44	46.45
18	1.608	1.775	1.593	1.645	48.12	57.27	48.22	55.32
Zahl der Gemessenen.	410	227	652	201	420	223	651	201

Bemerkt muss zu dieser Tabelle werden, dass im Alter von 16, 17, 18 Jahren nur wenige Mädchen, die nicht in Fabriken arbeiteten, gewogen wurden. Wieviel Kinder überhaupt in jeder Altersklasse gewogen und gemessen wurden, ist leider nicht angegeben; auf die wohl in einzelnen Altersklassen allzu geringe Zahl der Untersuchten, sind wahrscheinlich die Unstimmigkeiten der Tabellen zurückzuführen, doch ergibt sich aus ihnen im allgemeinen eine ungünstigere Körperentwicklung der Fabrikarbeit verrichtenden Kinder in den letzten beobachteten Altersclassen.

Bemerkt sei hier auch noch, dass es bereits Quetelet und vor ihm Villermé bekannt war, dass "der Wuchs der Männer unter im übrigen gleichen Umständen im Verhältnis zu den Vermögensumständen oder wenigstens in einem umgekehrten Verhältnis zu den Mühen, den Anstrengungen, den Entbehrungen, die sie in der Kindheit und Jugend zu erdulden haben, steht," eine Beobachtung, die seitdem von den verschiedensten Autoren sowohl bei Erwachsenen: Broca, Roberts u. Rawson, Tarnowsky, Pfitzner, Niceforo, als auch bei Kindern: Pagliani, Niceforo, der dänischen Schulkommission

u. a. vollinhaltlich bestätigt und von einzelnen dieser Autoren durch Ausdehnung der Untersuchung auf Brustumfang, Gewicht und Anderes erweitert wurde. Quirsfeld (Zeitschrift für Schulgesundheitspflege, 1905, Nr. 3, 4) formulirt seine Beobachtungen etwas anders: "Gleichalterige und beim Schuleintritt gleich grosse Kinder bemittelter Eltern erreichen bis zum Schlusse des 4. Schuljahres gegenüber den Kindern armer Eltern durchschnittlich eine um 7 Prozent grössere Körperlänge, einen um 4 Prozent grösseren Brustumfang, ein um 6 Prozent grösseres Körpergewicht."

Wie die eben citirte Arbeit, so bieten uns überhaupt jene zahlreichen, vor allem zu schulhygienischen Zwecken vorgenommenen Massenuntersuchungen von Schulkindern manches, wenigstens indirect verwertbare Material, denn aus dem, was über die schädlichen Folgen der Arbeit in der Schule festgestellt wurde, lassen sich wohl Schlüsse auf die Folgen kindlicher Erwerbsarbeit ziehen.

Wie ungemein empfindlich der Organismus im früheren Kindesalter gegen jede Art von Arbeitsleistung ist, zeigt am besten die Untersuchung Schmid-Monnards (Zeitschrift für Schulgesundheitspflege, etc., 1897, p. 593), der wir die folgende Tabelle entnehmen, wobei noch ausdrücklich bemerkt sei, dass jeder Angabe mindestens 50 Beobachtungen zu Grunde liegen. Diese Tabelle zeigt uns, um wie viel schlechter sich die Schule besuchende 6–7 jährige Kinder entwickeln als gleichalterige nicht die Schule besuchende Kinder. "In den ersten 3 Monaten des Schulbesuches verringert sich das Durchschnittsgewicht der Volksschulmädchen um ¾ Kg., ebenso zeigt sich bei allen Elementarschulkindern in dem nächsten Jahre ein verlangsamtes Tempo der Gewichtszunahme" fügt Schmid-Monnard noch den in Tabellenform niedergelegten Beobachtungen hinzu.

[Nach Schmid-Monnard.]

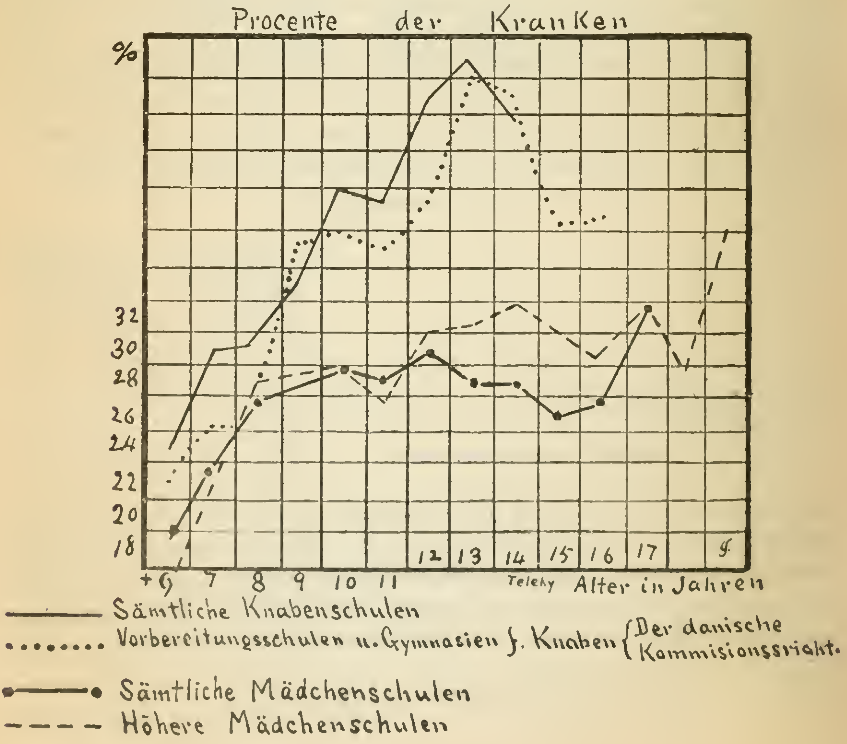
	Gewichtszunahme in Kilogramm während des 7. Lebensjahres.		Längenwachstum in Centimeter während des 7. Lebensjahres.	
	Knaben.	Mädchen.	Knaben.	Mädchen.
Nicht Schulpflichtige, 6–7jährige	2.2	1.9	7.4	5.6
Schulpflichtige, 6–7jährige	1.5	.6	4.2	4.5
Differenz zu Ungunsten der die Schule besuchenden	0.7	1.3	3.2	1.1

Quirsfeld bemerkt, dass die Entwicklung des Brustumfanges bei den Mädchen im allgemeinen gegenüber den Knaben zurückbleibt, diese Erscheinung aber am auffallendsten vom 3. zum 4. Schuljahr sich geltend mache, und er bringt dies damit in Zusammenhang, dass im 3. Schuljahr bei den Mädchen der Handarbeitsunterricht beginnt.

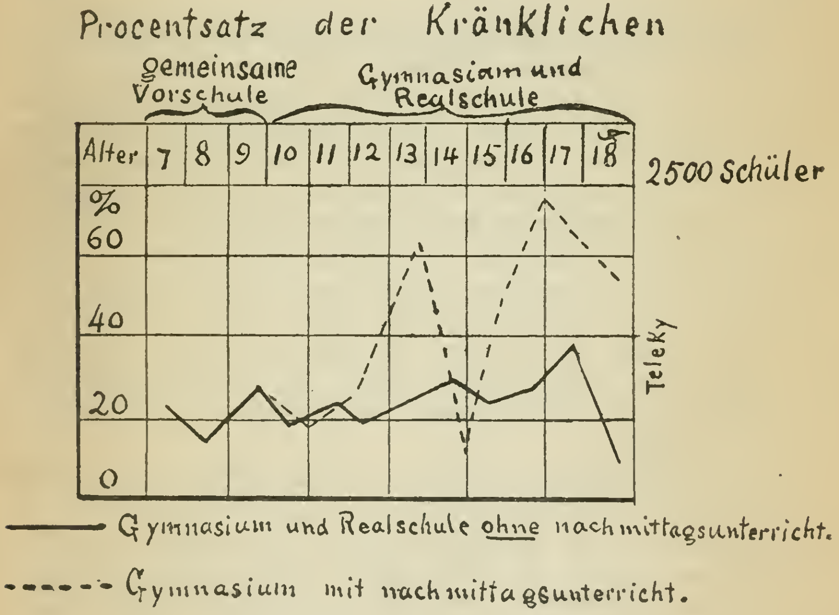
Ich habe oben darauf hingewiesen, dass nach allen Untersuchern die Kinder der Minderbemittelten in körperlicher Entwicklung hinter den der Bemittelten zurückbleiben; man würde demnach erwarten, dass diese letzteren auch weniger kränklich sind, und tatsächlich bestätigten diese Meinung auch die Untersuchungen Quirsfelds über die untersten 4 Schuljahre.

Betrachten wir aber die Kinder verschiedener Schulen, in denen verschiedene Ansprüche an die Arbeitskraft der Kinder gestellt werden, so zeigt sich bald eine Umkehr der Verhältnisse. Ich entnehme die beifolgende Curve, die die Ergebnisse des dänischen Commissionsberichtes wiedergibt, einer Arbeit Axel Hertels (Zeitschrift für Schulgesundheitspflege, 1888, Nr. 6):

Wir sind hier in der Lage die Krankheitsverhältnisse, d. h. den Procentsatz der kranken oder kränklichen Schüler in sämtlichen Knabenschulen mit den in den Vorbereitungsschulen und Gymnasien zu vergleichen und bei den Mädchen den in sämtlichen Mädchenschulen mit den in höheren Mädchenschulen, müssen aber leider hinzufügen, dass ein Unterschied im Erhebungsmodus die Verlässlichkeit des Vergleiches sehr beeinflusst; in den höheren Schulen wurde ein Attest des Hausarztes über den Gesundheitszustand den statistischen Zusammenstellungen zu Grunde gelegt, in den niederen Schulen durch eigene Aerzte Untersuchungen vorgenommen.



Bei den Mädchenschulen tritt im allgemeinen—mit Ausnahme eines Jahres—das Erwartete ein; die (schwächlichen) Mädchen in der Gesamtheit aller Schulen zeigen ein grösseres Prozent kranker als die ausschliesslich den höheren Schichten angehörenden (d. s. kräftigeren) Schülerinnen höherer Töchterschulen. Bei den Knaben aber zeigen vom 12. Jahre an die Gymnasiasten—trotzdem sie im allgemeinen zu den körperlich besser entwickelten höheren Schichten gehören—eine grössere Kränklichkeit als dem Durchschnitt der Schüler aller Schulen entspricht. Es ist wohl gestattet diesen Umstand mit der höheren von ihnen geforderten Arbeitsleistung in Zusammenhang zu bringen. Dass sowohl bei Knaben als bei Mädchen das Ende der Curve sämtlicher Schulen mit der Curve der höheren Schulen zusammenfällt, erklärt such daraus dass mit Aufhören der Schulpflicht in niedrigeren Schulen, der Verlauf der Curve sämtlicher Schulen nur ausschliesslich durch die der höheren Schulen bestimmt wird.



Deutlich zeigt sich der Einfluss der erhöhten Arbeitsleistung in den Untersuchungen Schmid-Monnards, der die Häufigkeit chronischer Kränklichkeit in den höheren Schulen mit und ohne Nachmittagsunterricht mit einander vergleicht. Mit Ausnahme des 14. Jahres ist vom 13. Jahre an in allen Altersklassen die Häufigkeit der Kränklichkeit in der Schule mit Nachmittagsunterricht um sehr vieles grösser, durchschnittlich doppelt so gross als in den Schulen, in denen nur Vormittags Unterricht erteilt wird.

Aus der ungeheuren Zahl von Arbeiten und Untersuchungen, die sich mit der Wirkung der Schule und der Arbeit in der Schule auf die körperliche Entwicklung und die Gesundheit der Kinder beschäftigen, haben wir nur diese wenigen Daten herausgehoben, wir wollen auch nicht näher auf jene Arbeiten eingehen, die die Schädigungen der Augen durch die Schularbeit—von Klasse zu Klasse zunehmende Zahl der Kurzsichtigen—darlegen oder die Häufigkeit der Rückgratsverkrümmungen infolge langen Sitzens auf ungeeigneten Subsellien.

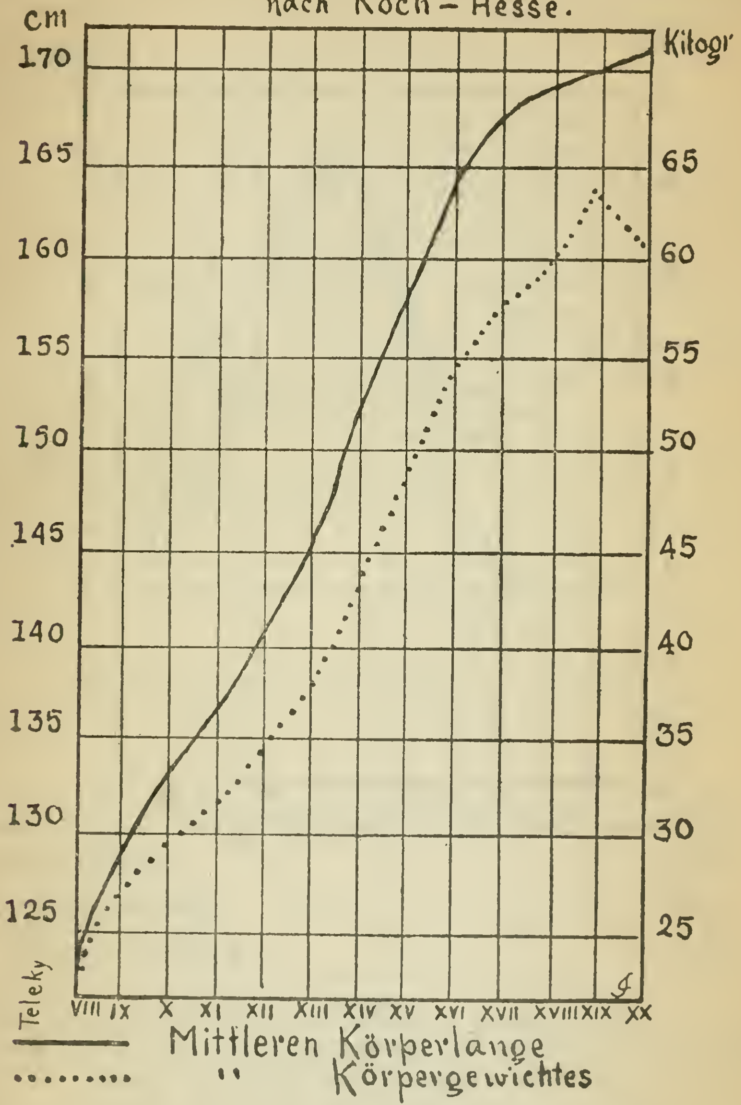
Aus allen diesen Untersuchungen geht mit aller Klarheit hervor, wie ungemein empfindlich nicht nur der kindliche, sondern der heranwachsende Organismus überhaupt auf jedes Mehr an Arbeit, auf jede stärkere Inanspruchnahme, auf jede äussere Schädlichkeit, mit Zurückbleiben in der Entwicklung mit erhöhter Kränklichkeit, mit irreparablen Veränderungen einzelner Organe oder Körperteile (Augen, Wirbelsäule) reagirt.

Wenn man neben ernsten und mühevollen Untersuchungen in den einschlägigen Fachblättern gar nicht selten pathetische Klagen über die schwere Schädigung der Volksgesundheit durch Ueberlastung der Schüler an den höheren Schulen und der Schülerinnen an höheren Töchterschulen findet—Klagen, die ein lebhaftes Echo in der Tagespresse finden—dann muss man sich wohl über den engen Gesichtskreis mancher dieser Herren wundern, die ganz daran vergessen, dass für die Gesundheit der Nation die Erwerbsarbeit von Kindern und Jugendlichen schädlicher ist als die Ueberarbeit an höheren Schulen, die ja nur von einem kleinen Bruchteil der Kinder besucht werden und deren Anforderungen ja nur eine Elite gewachsen sein soll. Ein Teil des auf die Reform der höheren Schulen aufgewandten Pathos hätte wahrscheinlich genügt, um weiterer gesetzlicher Einschränkung der Erwerbsarbeit von Kindern und Jugendlichen die Wege zu ebnen.

Mit wieviel Jahren, und in welchem Ausmasse soll das Kind zur Erwerbsarbeit zugelassen werden?

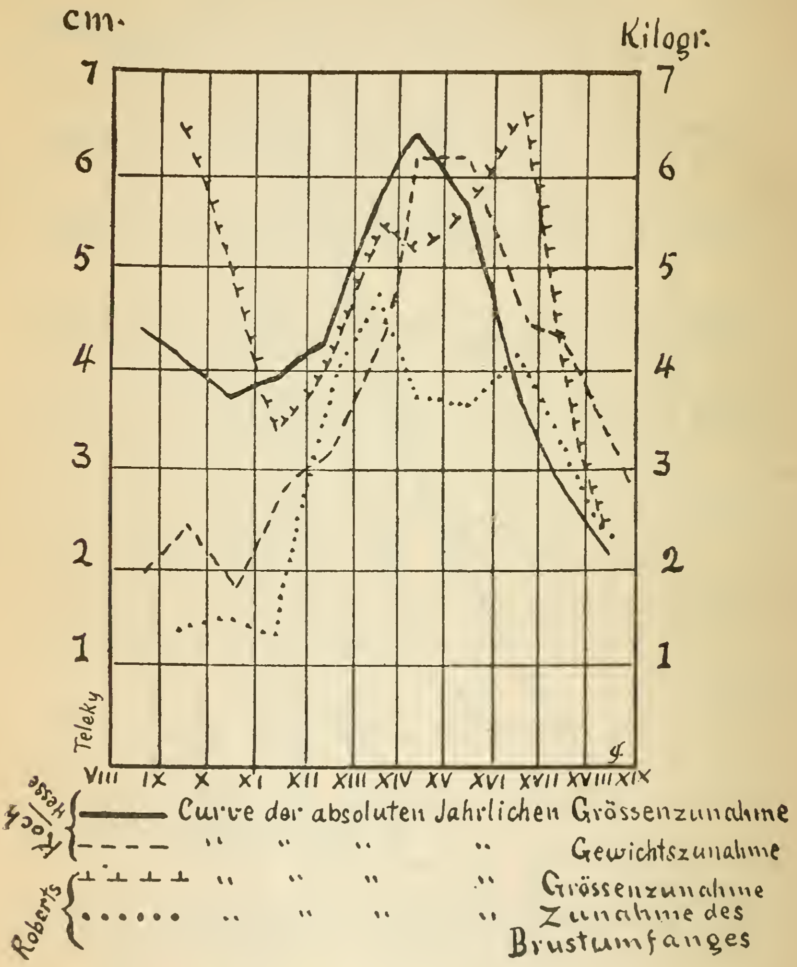
Betrachten wir die Wachstumscurven nach irgend einem der verschiedenen Autoren, die entsprechende Messungen und Wägungen vorgenommen haben, z. B. nach den genauen Ermittelungen Koch-Hesses (Zeitschrift für Schulgesundheitspflege, 1905) so sehen wir ein fast gleichmässiges Ansteigen der Körperlänge bis zum 17., des Körpergewichtes bis zum 19. Lebensjahre. Betrachten wir genauer das Wachstum in jedem einzelnen Lebensjahr, so sehen wir nach Koch-Hesse, der in einem Jenaer Institut für Wohlhabende seine Messungen vornahm, die stärkste Grössenzunahme im 15., aber auch noch in den folgenden Jahren eine sehr bedeutende Grössenzunahme; nach anderen Autoren fällt das Maximum der Grössenzunahme in späteres Alter, so nach Kotelmann (Schüler des Johanneums in Hamburg) ins 16., nach Bowditsch und Roberts (englische Schüler) ins 17. Lebensjahr (citirt nach Gruber, Schriften der Gesellschaft für soziale Reform Heft 38, 39). Das Maximum der

Zöglinge der Stoyschen Erziehungsanstalt in Jena nach Koch-Hesse.



Gewichtszunahme fällt in das 15. Jahr (nach Koch-Hesse), in das 16. (nach Roberts und Bowditsch) aber auch in den nächstfolgenden Jahren ist die Gewichtszunahme eine sehr bedeutende.

Bei dieser allmählich und bis zum 18. und 19. Jahre in raschem Tempo—wenn auch in den letzen dieser Jahre bereits etwas verlangsamt—fortschreitenden Entwicklung, auf Grund physiologischer Erwägungen eine Grenze ziehen zu wollen, von der an Erwerbsarbeit gestattet sein soll, ist unmöglich; insbesondere ist zu bedenken, dass ja Erwerbsarbeit nicht die erste Arbeit ist, die der heranwachsende Mensch zu leisten hat; die Erwerbsarbeit tritt an Stelle der Schularbeit. Sie unterscheidet sich von der letzteren aber nicht nur durch ihre wirtschaftliche Bedeutung, sondern vor allem auch dadurch, dass während die Schularbeit der Weiterentwicklung des kindlichen Geistes und Körpers zu dienen bestimmt ist, die Erwerbsarbeit natürlich auf diese Momente keine Rücksicht nehmen kann. Erwerbsarbeit ist, wenn sie gewerbliche Arbeit ist, häufig von



grosser Monotonie, sie beschäftigt oft nur einzelne Muskelgruppen diese aber in übermässigem Masse, zwingt zu vielstündigem Sitzen, und weder Lüftungsverhältnisse noch Subsellien entsprechen jenen Anforderungen, die heute (wenigstens in den Städten) an die entsprechenden Schuleinrichtungen gestellt werden. Arbeit in der Landwirtschaft ist häufig körperlich anstrengend, und verkürzt oftmals den Kindern die gerade ihnen so notwendige Nachtruhe; das letztere gilt auch von den Austrägerdiensten und zum Teil auch von der Arbeit in Wirtsgeschäften.

Wenn es aber unmöglich ist auf Grund physiologischer Erwägungen eine Altersgrenze zu bestimmen, von der an Erwerbsarbeit überhaupt oder irgend eine Art der Erwerbsarbeit für den kindlichen Organismus nicht mehr schädlich ist, so können wir doch sagen, dass jeder rasche Uebergang in neue Verhältnisse, jede plötzliche Uebernahme neuer, schwerer Pflichten auf den jugendlichen Organismus nachteilig einwirkt; am nützlichsten für die heranwachsende Generation wäre der allmähliche Uebergang aus der Schule mit Handfertigkeitsunterricht in die Lehrwerkstätte mit weiterem anfangs recht reichlich bemessenem Fortbildungsunterricht.

Anderseits können wir versuchen zu ermitteln wie die ersten Jahre der Arbeit, insbesondere die in der "Lehre" oder der Fabrik auf die Gesundheit unserer Jugendlichen einwirken. Daten hierüber liefert uns die Krankenkassenstatistik und die österreichische, speciell die Wiener Statistik erscheint uns für diese Zwecke besonders geeignet. Erfolgt doch hier der Eintritt ins Erwerbsleben relativ—d. h., im Vergleich mit anderen Ländern—spät. Kinder dürfen vor vollendetem 14. Lebensjahr in Fabriken überhaupt nicht beschäftigt werden, hingegen ist Beschäftigung von Kindern bis zur Dauer von 8 Stunden täglich vom vollendeten 12. bis zum vollendeten 14. Lebensjahr in kleingewerblichen Betrieben gestattet, "sofern ihre Arbeit der Gesundheit nicht nachteilig ist und die körperliche Entwicklung nicht hindert, dann der gesetzlichen Schulpflicht nicht im Wege steht." Da die gesetzliche Schulpflicht bis zum vollendeten 14. Lebensjahre dauert, sogenannte "Schulbesuchserleichterungen," die anderwärts eine grosse Rolle spielen, in Wien so gut wie gar nicht, resp. höchstens für wenige Wochen vor Vollendung des 14. Lebensjahres erteilt werden, so erfolgt in Wien der Eintritt ins Erwerbsleben mit vollendetem 14. Lebensjahr (abgesehen von der nicht sehr verbreiteten Heimarbeit der Kinder). In Fabriken dürfen 14–16 jährige nur unter denselben Beschränkungen (jedoch bis 11 Stunden) beschäftigt werden wie 12–14 jährige im Kleingewerbe. Bis zum vollendeten 16. Lebensjahr ist die Nachtarbeit, d. h., Arbeit zwischen 8 Uhr abends bis 5 Uhr morgens in allen Arten von gewerblichen Betrieben—abgesehen von den durch das Handelsministerium gewährten Ausnahmen—verboten.

Trotzdem lehrt uns die Krankenkassenstatistik, dass die Erkrankungshäufigkeit der jugendlichen Arbeiter eine exorbitant hohe ist, wobei noch bemerkenswert, dass nicht unmittelbar nach Eintritt ins Erwerbsleben, in Alter von 14 Jahren die grösste Erkrankungshäufigkeit eintritt, sondern scheinbar erst dann, wenn alle Schädlichkeiten der Berufsarbeit längere Zeit gewirkt—im bemerkenswerten Gegensatz zu dem oben über den Schuleintritt gesagten. Auch ist es von Interesse, dass in der kaufmännischen (Gremial-) Krankenkasse die Erscheinung nicht so deutlich zu Tage tritt wie in den übrigen Krankenkassen, was wohl darauf zurückzuführen, dass die Angehörigen der ersteren Kasse weniger körperliche Arbeit zu leisten haben.

Bei den Wiener Krankenkassen kommen (meist 1892–1902) auf 100 des durchschnittlichen Mitgliederstandes mit Arbeitsunfähigkeit.

[Nach S. Rosenfeld, Statistische Monatsschrift 1905.]

Alter in Jahren.	Erkrankte.		Erkrankungen.	
	Männer.	Frauen.	Männer.	Frauen.
14	37.61	22.92	43.82	26.99
15	62.94	41.52	81.50	49.13
16	58.78	40.28	75.81	49.88
17	43.28	39.06	54.51	48.45
18	37.46	38.22	46.40	47.68
24	34.54	36.28	34.72	40.12

[Nach S. Rosenfeld, Statistische Monatsschrift 1905.]

Alter in Jahren.	Krankenprozent.				Erkrankungsprozent.			
	Bezirks-Kranken-Kasse.	Allg. Arbeiter-Kranken-Kasse.	Genossenshafts-Kranken-Kasse.	Gremial-Kranken-Kasse.	Bezirks-Kranken-Kasse.	Allg. Arbeiter-Kranken-Kasse.	Genossenshafts-Kranken-Kasse.	Gremial-Kranken-Kasse.
Unter 15	161.11	34.27	38.75	....	189.26	45.93	46.17	....
16–20	50.18	42.12	31.35	17.80	58.39	57.35	38.76	20.91
21–25	28.89	39.16	26.15	16.81	34.74	53.40	33.10	20.40

Erwähnt sei hier auch, dass Kaup (Die jugendlichen Arbeiter in Deutschland. Schriften der Gesellschaft für soziale Reform, Heft 36) über ähnliche Erfahrungen in deutschen Krankenkassen berichtet, und auch—nach Kayserlings Untersuchungen—darauf hinweist, dass während die Tuberkulosesterblichkeit in Deutschland in den anderen Altersklassen sinkt, die für die Altersgruppe vom 15.–20. Lebensjahre in Berlin für junge Männer seit 1896 unverändert geblieben ist, während sie in dieser Altersgruppe in den letzten Jahren für das weibliche Geschlecht, das in immer grösserem Umfange am Erwerbsleben teilnimmt, sogar etwas ansteigt.

Pirquet führt es auf die Einwirkung der Berufsarbeit zurück, dass die Tuberkulosemortalität, die vom 5.–15. Lebensjahr relativ so gering, vom 15.–20. Lebensjahr um so viel grösser ist.

Auch die Unfallgefährdung jugendlicher Arbeiter ist eine ganz abnorm hohe. Nach der Statistik der Leipziger Ortskrankenkasse entfielen von allen Arten von Unfällen (Unfälle überhaupt, Betriebsunfälle, leichtere und schwerere Unfälle, leichtere und schwerere Betriebsunfälle)—mit alleiniger Ausnahme der tötlichen Unfälle—relativ sehr viel mehr auf die Jahre unter 19, und da wieder besonders viel auf die unter 15 Jahren als auf die folgenden Altersklassen.

Nach Statistik der Leipziger Ortskrankenkasse entfielen auf 100 ein Jahr lang beobachtete Personen:

	Unfälle überhaupt—		Darunter Betriebsunfälle—		Unfallkrankheitstage aus Fällen—		Darunter Betriebsunfall krankheitstage aus Unfällen—		Mehr als 13 Wochen dauernde Betriebsunfälle.	Tötliche Betriebsunfälle.
	Bis 28 Tage.	Über 28 Tage.	Bis 28 Tage.	Über 28 Tage.	Unter 28 Tagen.	Über 28 Tage.	Über 28 Tage.	Unter 28 Tagen.		
Unter 15 Jahren	12.42	1.90	4.66	1.06	144.72	92.24	59.69	55.43	0.179	....
15–19 Jahren.........	10.18	1.40	3.69	.79	112.89	67.14	44.66	38.16	.075	12
20–24 Jahren.........	7.67	1.04	2.95	.67	81.57	53.64	34.29	35.27	.093	18
25–29 Jahren.........	7.28	1.15	3.07	.75	79.96	62.19	36.23	41.53	.140	17

Mag von den Unfällen manches auf die Ungeübtheit jugendlicher Arbeiter zurückzuführen sein, so kommt doch auch manches auf Uebermüdung, manches auf die mangelnde körperliche und geistige Reife der Jugendlichen.

Zweifellos aber geht aus all diesen Angaben hervor, dass der gegen jedes Uebermass von Arbeit so ungemein empfindliche heranwachsende Organismus selbst im 15. Lebensjahre—in welchem Jahre in Oesterreich und Deutschland meist der Austritt aus der Schule, der Uebertritt in die Erwerbsarbeit erfolgt—den Anforderungen, die diese letztere in ihrer heutigen Gestalt an ihn stellt, nicht gewachsen ist. Wir werden also vom hygienischen Standpunkte aus ein Hinaufrücken des Schutzalters, ein Verbot der Arbeit in Gewerbebetrieben und Fabriken vor vollendetem 16. Lebensjahre fordern müssen, wenn wir uns auch der wirtschaftlichen Schwierigkeiten, die der Erfüllung dieser Forderung entgegenstehen, wohl bewusst sind.

In gesundheitlicher Hinsicht der Arbeit in Gewerbebetrieben und Fabriken gleich zu stellen, ja infolge mangelhafter Arbeitsräume und überlanger Arbeitszeit noch bedenklicher als diese, ist die Heimarbeit.

Landwirtschaftliche Arbeit unterscheidet sich von gewerblicher in hygienischer Beziehung vor allem dadurch, dass sie meist in freier Luft erfolgt; wenn aber von mancher Seite behauptet wird, dass die landwirtschaftliche Arbeit der Kinder leichte Arbeit sei, so ist darauf hinzuweisen, dass einerseits Kinder auch zu landwirtschaftlichen Arbeiten schwerster Art: Mähen, Dreschen, Häckerling-schneiden verwendet werden, dass aber auch Arbeiten, die an sich nur geringe Kraft erfordern, z. B., Engerlinge klauben, Raupen abklauben u. dergl. durch einige Stunden fortgesetzt, doch zu schwerer Anstrengung werden, wie ja auch das Aufnähen von Knöpfen, Auffädeln von Perlen u. dergl. in der Hausindustrie nicht an sich, sondern erst durch längere Zeit fortgesetzt, anstrengt und ermüdet.

Aber auch der Organismus des 16jährigen ist noch nicht jeder Arbeit gewachsen, auch er muss noch vor überlanger Arbeitszeit, sowie vor Arbeiten, die besondere Schädlichkeiten mit sich bringen: Arbeit in hoher Temperatur, Arbeit unter Tags, Nachtarbeit geschützt werden. Die Arbeitszeit jugendlicher Personen im Alter von 16–18 Jahren ist durch die Gesetzgebung zu begrenzen und soll 8 Stunden täglich nicht übersteigen.

Mit Recht verlangt Kaup—allerdings für die männlichen Jugendlichen von 14–18 Jahren—dass die in Fortbildungs- und Fachschulen verbrachte Zeit (mindestens 2 Halbtage wöchentlich) in die gesetzlich zulässige Arbeitszeit einzurechnen und wöchentlich mindestens ein Halbtag (ausser dem Sonntag) für körperliche Uebungen freizugeben ist. Er nähert sich damit auch für Knaben der Forderung nach Halbtagsschichten, die er für die weibliche Jugend verlangt, und die wohl geeignet sind den Eintritt ins Erwerbsleben zu einem allmählichen zu gestalten. Auch der Forderung Kaups nach einem 2 wöchentlichen Sommerurlaub wird man beistimmen müssen.

Die Arbeit Jugendlicher ist in allen Betrieben, in denen giftige Substanzen entstehen, erzeugt oder verwendet werden, zu untersagen, da der jugendliche Organismus einerseits für Giftstoffe besonders empfänglich ist, anderseits von Jugendlichen nicht jene Vorsicht und jene strenge Durchführung der persönlichen Prophylaxe erwartet werden kann, die in solchen Betrieben notwendig ist.

Weitergehenden Schutz als männliche jugendliche Arbeiter bedürfen junge weibliche Arbeiter. Für diese sind die Jahre der Pubertät besonders kritische, die Vorgänge, die zur Entwicklung der Geschlechtsreife führen, erschüttern den weiblichen Organismus weit mehr als den männlichen, die Sterblichkeit des weiblichen Geschlechtes, die im allgemeinen eine günstigere ist als die des männlichen, ist gerade in den späteren Entwicklungsjahren in manchen Ländern eine grössere (Tabelle nach Westergaard). Aber auch in jenen Ländern, in denen im Gegensatz zu England und ähnlich wie in Norwegen die Gesamtsterblichkeit des weiblichen Geschlechts in den Jahren 15–20 kleiner ist als die des männlichen Geschlechtes, (in Preussen und Bayern) ist die Tuberkulosesterblichkeit in diesen Jahren beim weiblichen Geschlecht grösser (Tabelle nach Prinzing).

Von 100,000 in Alten X lebenden starben.

[Nach Westergaard.]

	England.		Norwegen.	
	Männer.	Weiber.	Männer.	Weiber.
10 Jahre	195	167	471	529
11 Jahre	177	156	454	484
12 Jahre	181	167	441	473
13 Jahre	203	197	450	481
14 Jahre	240	241	453	506
15 Jahre	287	295	505	523
16 Jahre	338	351	552	527
17 Jahre	386	401	651	546
18 Jahre	425	441	775	560
19 Jahre	456	469	854	564
20 Jahre	480	489	912	564
21 Jahre	502	506	958	624
22 Jahre	526	524	1,006	635
23 Jahre	557	550	987	640
24 Jahre	594	583	936	680

Auf 100,000 Lebende kamen Todesfälle an Tuberkulose der Lunge und anderer Organe.

[Nach Prinzing.]

Alter.	Preussen, 1896–1900.		Bayern, 1899–1901.		Schottland, 1891–1900.		Italien, 1897–1900.		Schweiz, 1881–1890.	
	Männer.	Weiber.	Männer.	Weiber.	Männer.	Weiber.	Männer.	Weiber.	Männer.	Weiber.
5–10 Jahre	37	50	67	90	103	121	82	104	90	119
10–15 Jahre	46	83	54	108	85	153	54	116	173	291
15–20 Jahre	147	160	163	219	214	277	140	236	340	363
20–30 Jahre	266	233	341	336	326	307	244	277	402	339
30–40 Jahre	290	261	378	364	299	305	....	....	....	....

Ich habe bisher stets von Altersgrenzen gesprochen: Eine Altersgrenze, unterhalb der kindliche Arbeit verboten, oberhalb der sie—und zwar zunächst nur in beschränktem Masstabe—gestattet sein soll, während erst von einer weiteren Grenze an der Arbeiter als voll leistungsfähiger Arbeiter anzusehen ist. Es könnte nun eingewendet werden, dass bei den so ungemein grossen Verschiedenheiten, die zwischen den einzelnen Individuen bestehen, die Festsetzung einer Altersgrenze eine allzu schematisirende Massregel ist, dass einer solchen Festsetzung eine Bestimmung, die die Beschäftigung eines Kindes—ohne Rücksicht auf sein Alter—von der Beibringung eines ärztlichen Zeugnisses abhängig macht, vorzuziehen wäre. Mehrere Momente aber müssen eine derartige Regelung der Frage der Kinderarbeit als unmöglich erscheinen lassen: Zunächst wäre dadurch ein allzu grosser Spielraum der individuellen Ansichten des einzelnen Arztes gegeben, allzu sehr würden bei der Entscheidung die persönlichen Ansichten des einzelnen Arztes über Schwere der Arbeit, Wirkung der Arbeit auf den kindlichen Organismus ins Gewicht fallen; dann ist es auch für die Eltern wichtig, von vornherein zu wissen, von welchem Jahre an ihre Kinder sich ihren Lebensunterhalt ganz oder teilweise zu erwerben im Stande sein werden; vor allem aber müssen die Bestimmungen über Schulpflicht und über Kinderarbeit in einander greifen, es muss dafür gesorgt sein, dass das Kind während der Dauer der Schulpflicht von Gewerbsarbeit möglichst ferngehalten werde, anderseits aber muss dafürgesorgt sein, dass—so lange das Kind zur Erwerbsarbeit nicht zugelassen wird—es in der Schule Beschäftigung findet.

Von diesen Erwägungen ausgehend, ist man wohl überall zur Festsetzung von Altersgrenzen gelangt. Vom hygienischen Standpunkte aus, sowie mit Rücksicht auf das eben erwähnte möglichst allgemein durchzuführende Ineinandergreifen von Dauer der Schulpflicht und Schutzalter, erscheint es notwendig, das Schutzalter so hoch anzusetzen, dass bei Erreichung der Altersgrenze jedes Kind—von seltenen Ausnahmen abgesehen—wenigstens für irgend einen Beruf, wenigstens insoweit arbeitsfähig ist, als das Gesetz die Arbeit gestattet.

Soll nun nach Erreichung dieses Alters die Zulassung zur Arbeit überhaupt, zur Arbeit in einer grossen Gruppe von Betrieben oder zur Arbeit in bestimmten Berufen von dem Ergebnis einer ärztlichen Untersuchung abhängig gemacht werden?

Bei entsprechend hochgestelltem Schutzalter erscheint es überflüssig, die Zulassung zur Erwerbsarbeit im allgemeinen von einer ärztlichen Untersuchung abhängig zu machen. Bei niedrig gestelltem Schutzalter und damit in Zusammenhang stehender frühzeitig beendigter Schulpflicht, würde die praktische Durchführung der vom Arzt verfügten Fernhaltung von Erwerbsarbeit auf die grössten Schwierigkeiten stossen.

Bei hochgestelltem Schutzalter wäre es auch überflüssig die Zulassung zu einer grossen Gruppe von Betrieben, z. B. wie es das englische Gesetz vorschreibt, für alle Fabriken (und ausserdem für einige Arten von Werkstätten) von einer ärztlichen Untersuchung abhängig zu machen. Auch kann ich mich wenigstens nicht des Gedankens erwehren, dass die Kinder, die auf Grund der Verweigerung eines ärztlichen Zeugnisses zu dem weitaus grössten Teil der Erwerbsmöglichkeiten, z. B. zur Fabriksarbeit nicht zugelassen werden, dann Beschäftigungen anderer Art suchen und finden, die für ihre Gesundheit oft noch weniger zuträglich sind, Arbeiten in Werkstätten, in der Heimarbeit und beim Strassenhandel. Es besteht die Gefahr, dass bei auf so grosse Gruppen von Betrieben ausgedehnter obligatorischer und streng durchgeführter Untersuchung gerade die Schwächlichen in schlecht bezahlte und hygienisch ungünstige Berufe gedrängt werden.

Es sind vielleicht Erwägungen dieser Art, sowie der Umstand, dass die Untersuchungen erst, nachdem das betreffende Kind einen Arbeitsplatz gefunden hat, vorgenommen werden, die dazu führen, dass die Zahl der von den englischen certifying surgeons vorgenommenen Zurückweisungen eine recht geringe ist. Von 423,195 Untersuchten (1910) wurden 13,203 zurückgewiesen, von diesen jedoch nur 8,469 aus medizinischen Gründen, zu denen auch "Mangel an Reinlichkeit" (in 3,962 Fällen) gerechnet wird, so dass von 423,195 Untersuchten aus medizinischen Gründen im engeren Sinne nur 4,507- 1.06 Prozent zurückgewiesen wurden. Bemerkenswert ist, dass seit 1901 die certifying surgeons das Recht haben, die Tauglichkeitserklärung an Bedingungen zu knüpfen und dass viele von ihnen—wie aus den Berichten Deardens und Glen Park's auf dem Brüsseler Congress für Gewerbekrankheiten 1910 hervorgeht- in höchst anerkennenswerter Weise ihre Tätigkeit nicht auf die Ausstellung von Zeugnissen beschränken, sondern den Untersuchten, besonders wenn sie irgendwelche Mängel zeigen, Ratschläge für Ergreifung einer geeigneten Beschäftigung geben.

Notwendig aber erscheint es mir, die Zulassung zu bestimmten Berufen oder Beschäftigungszweigen, die besondere Ansprüche an die Körperkräfte oder die Widerstandsfähigkeit und Gesundheit einzelner Organe stellen, von dem Ergebnis einer ärztlichen Untersuchung abhängig zu machen. Als solche Berufe wären anzusehen: Hüttenarbeiter, Schmiede, Steinmetze, Bäcker, Arbeiter in Giftbetrieben und einige andere Arbeitergruppen. Die Zahl dieser Berufe aber sollte eine sehr beschränkte sein und eben nur jene umfassen, die ganz besondere Anforderungen an den Organismus stellen. Für diese Beschränkung auf wenige Berufe sprechen zwei Momente. Vor allem ist es sehr schwierig bei einem 14- oder 16jährigen eine Prognose über seine weitere körperliche Entwicklung zu stellen, von dieser Prognosenstellung aber hängt, sobald die Untersuchung nicht die Auslese nur ganz besonders kräftiger zum Zwecke hat, unsere Entscheidung ab. Dann aber wird bei weiterer Ausdehnung der obligatorischen Untersuchung und ihrer strengen Handhabung der Arbeitsmarkt für die Schwächlichen allzusehr eingeschränkt und diese werden, wie wir ja bereits oben erwähnt, dann in Berufe gedrängt, die für sie oft schädlicher sind als die, aus denen wir sie ausschliessen.

Bin ich so der Meinung, dass die Beibringung eines Tauglichkeitszeugnisses nur in sehr beschränktem Umfange obligatorisch gemacht werden soll, so halte ich es anderseits für wünschenswert, dass das Moment der körperlichen Eignung mehr als bisher bei der Berufswahl Berücksichtigung finde.

Heute treibt zwar, wie Dr. M. Winter in seinem Bericht über die Tätigkeit der Schulärzte an den gewerblichen Fortbildungsschulen ausführt (Österreichisches Sanitätswesen, 1911) die "natürliche Berufswahl" den Kräftigen zum Schmiedehammer, während der schwächliche zur Nadel greift, und auch die Lehrherren und Arbeitgeber üben eine gewisse oberflächliche Auslese—Krankheiten aber, die dem Arbeitsuchenden selbst unbekannt, z. B. gut compensirte Herzfehler und körperliche Abnormitäten, die dem Betreffenden noch keine Beschwerden verursachen, die aber gerade durch Ausübung eines bestimmten Berufes sehr gesteigert werden können und dann heftige Beschwerden machen (z. B. Plattfüsse bei Kellnern und Drechslern), finden bei der Berufswahl keinerlei Berücksichtigung. Es sollte dafür gesorgt werden, dass neben allen oft recht berücksichtigenswerten Momenten, die heute für die Berufs "wahl" massgebend—oft spielt der Zufall dabei die grösste Rolle—auch die körperliche Eignung Berücksichtigung finde.

Ich stehe seit drei Jahren einer ärztlichen Beratungsstelle für die Berufswahl vor, für die in Arbeiterkreisen lebhafte Propaganda gemacht wird. Doch kann durch solche Einrichtigungen der nach dieser Richtung bestehenden Gleichgiltigkeit nicht wirksam entgegengetreten werden. Hier ist ein Eingreifen der Schule notwendig. Die vor Vollendung der Schulpflicht stehenden Knaben und Mädchen sind vom Lehrer auf die Wichtigkeit der körperlichen Eignung für die Berufswahl aufmerksam zu machen, und der Schularzt, der ja die meisten Schüler seit langem kennt, ist der berufene Ratgeber. In einzelnen deutschen Städten wird dieser Vorgang eingehalten. Wo Schulärzte nicht angestellt sind, wäre wenigstens für Untersuchung und Beratung der vor Schulaustritt stehenden Schüler ein Arzt zu bestellen. Der Arzt hätte dann durch im Bedarfsfalle eindringliche Belehrung dafür zu sorgen, dass die körperliche Beschaffenheit des Schülers bei der Berufswahl berücksichtigt wird, wobei er sich allerdings wird vor Augen halten müssen, dass körperliche Eignung zwar ein wichtiges Moment, aber keineswegs das einzige oder allein zu berücksichtigende ist. Nur dann aber wird der Arzt ein nützlicher Berater sein können, wenn er über die verschiedenen Berufe und Arbeitsverrichtungen aus eigener Anschauung genau unterrichtet ist. Hier genügen nicht allgemeine medizinische Kenntnisse, auch nicht allgemeine gewerbehygienische Kenntnisse, sondern der Arzt, der hier nützlich wirken will, muss über genaueste Kenntnis der Arbeitsverhältnisse und der Werkstättenverhältnisse in den einzelnen Berufen verfügen und er muss auch wissen, zu welchen Arbeitsverrichtungen Jugendliche in den einzelnen Berufen vor allem herangezogen werden. Solche Kenntnisse aber können nicht aus Büchern geschöpft, sie müssen durch eigene Anschauung erworben werden.

THE LABOR AND WORK OF CHILDREN SHOULD BE ADAPTED TO THE INDIVIDUAL CHILD.

Thomas Morgan Rotch, M. D., Boston.

A great deal of thought has been given to and work done on the subject of determining how the early years of life can be classified into divisions for various purposes—educational and physical. Divisions, however, that have so far been made are rather unsatisfactory and have often been based in great measure upon the chronologic age of the individual. When we consider how greatly individual children differ from each other in mental and physical development, even though they may be of about the same chronologic age, it becomes apparent that a much broader method of classification is necessary if we expect to do justice to the capabilities, both mental and physical, of the individual child.

It is well known from a medical point of view that mental and physical conditions should not be overstrained by being brought into use before the development adapted to such use is established; and, on the other hand, that functions, both mental and physical, are weakened by not being brought into use when they are ready to be used.

If we assume that it is the individual whose welfare should be looked after as to the time when he should begin to work and the kinds of work which he should be allowed to do, a number of factors must be considered in the problem. First of all, it should be understood that the mental condition of the individual child should be carefully determined, in order to decide whether it is such that he should be allowed to work at all. Taking for granted that the mental condition and the degree of knowledge attained, according to his probable future vocation, justify the individual in beginning to work, the problem to be solved is whether his physical condition is such that work will not harm him.

It should be impressed upon educators and upon those who determine the physical fitness for labor that when the degree of mental development and general health is satisfactory, and it has been decided that labor should be begun, the kind of labor itself should be classified and the individual should be allowed to undertake the degree of labor which is best adapted to his physical condition.

What I am about to say I have already stated in part in previous publications, but I am taking the liberty of repeating somewhat, as this paper is to be presented largely to a new audience. I am also stating my views regarding the grading in schools, because the two conditions, mental and physical, at all ages up to adult development seem to be so closely allied.

Assuming that some additional means of classification is necessary in order to obtain the greatest good for the greatest number, a few words in regard to the classifications now used are desirable. It is well to say; however, that the advanced methods of determining mental development are not here under discussion, since the physical side of the question is now being dealt with. There is little doubt, however, but that mental and physical development are closely associated.

Former classifications have been based largely upon chronologic age, upon the weight and height, and upon the development of the teeth. In regard to the latter the consensus of opinion among odontologists is that the eruption of the teeth, as an index of either chronologic or anatomic age, is illusive. It is well known that tables compiled to show the average weight and height of individuals at certain ages are misleading in particular instances where great differences are manifest in well, strong children of the same age. The various forms of examination for the determination of the physical condition of an individual should be used as at present, and it is not my intention in this paper to go into a detailed discussion of these forms, or in any way to criticise their utility. A greater or less height or weight, according to race, family, or environment, than that which is found to correspond to the average age, may or may not indicate some abnormal condition, but in the general determination for fitness for work these factors of the problem have an important bearing on the final result. In like manner any irregularity in the development of the teeth has its own special significance. The normal or abnormal condition of the bones, the chest expansion, and the muscular strength all have an important bearing on the solution of the problem as to the fitness of the individual to begin physical work.

The important point to be borne in mind is that we must determine the fitness of each individual for school and physical work in the early years of life, and that the former basing of the grades in school and the fitness of the individual to do certain grades of work, upon chronologic age is insufficient. Although in numbers of cases children of the same chronologic age can be safely placed in the same grade in school, this wholesale classification has in many cases proved to be inadequate where, as is only right, we are endeavoring to provide for the good of the individual.

The object to be attained in grading for the schools is the keeping, so far as is possible, the mental and physical development in equipoise. If a child is found, by the examinations already made use of in the grading in the schools, to be mentally much in advance of his physical development, special care should be given to him and he should be kept back in his studies, rather than advanced, until it is ascertained that his mental condition is not being overtaxed. If, on the other hand, the physical is about equal to the mental development, there is not much danger of overtaxing the brain, and not so much care in supervision is required. If the physical is evidently ahead of the mental development, there will probably be no danger of overtaxing the brain. Again, if there is an advanced mental development, and with it a correspondingly advanced physical development, the individual should be allowed to be placed in a grade above that in which, according to his years, he would usually be placed. It is the very bright children of a low grade of physical development of whom we should be especially careful in advancing in the grades in school. Masters in the schools have told me that it is impossible, when grading the children, to say which child will eventually have to be withdrawn from school or placed in a lower grade on account of a physical breakdown, and they are most desirous of obtaining some additional method of examination which will aid them in determining which children would be likely to break down, and would consequently require special care in grading.

In like manner, in regard to labor, the individual with an undeveloped physical condition should not be allowed to enter upon work which has been determined to be proper for a given age, whether he is of such age or not. In certain classes of work, as in the Naval Academy, at Annapolis, it has been found impossible, with the usual means of physical examination, to determine which men will prove, after a year or two, to have been unfit to have entered upon the work of the school. This has been shown by their lack of physical endurance, which has necessitated their being dropped from the academy or into a lower class, thus involving a loss of time to themselves and unnecessary expense to the Government.

Another reason why the basing of our grades of classification upon chronologic age alone is insufficient is the fact that the real age of many children in our country is not known. The fact is that each child should be a law unto itself, and this can be accomplished only by a knowledge of the physical conditions of the special child. It is well known that parents and guardians, in many cases anxious that their children should obtain work, by which they will become wage earners, falsify the ages of their children over and over again. Such falsification can not play its pernicious rôle when the word of such parents and guardians is set aside and the child's actual physical condition has been determined. It has, indeed, been brought to my attention by mill owners that they have great difficulty in keeping unsuitable children out of the mills when they have reached, according to their parents, an age when the law allows them to begin work. In Massachusetts there is a law requiring every child to present a certificate of birth before receiving a working certificate, and in Boston there is a regulation of the school board requiring every child to present a certificate of birth upon entering school.

It is evident, therefore, that some additional aid for determining the fitness of an individual, either for his school or physical work, beyond the usual examinations for fitness, is required. With this in mind, I have for some years been making a study of additional means for determining the relation of physical fitness to certain degrees of labor and to school work. I have done this with the view of protecting the individual child, always taking into consideration the importance of recognizing what a great rôle in normal development is played by fresh air, general hygiene, and protection from mental overstrain.

The close relation which is known to exist between physical growth and the development of the epiphyses led me to make some investigations by means of the Roentgen ray on the living anatomy of early life during the different stages of development. A study of a large number of cases with Dr. A. W. George, roentgenologist to the Children's Hospital, showed that under normal conditions all the centers of ossification progressed with comparative regularity, and that the degree of development of the wrists and hands represented, to a fair degree, that of the entire bony framework. This correspondence of the development of the wrists and hands to that of the rest of the skeleton is especially fortunate, as it is evident that the wrists and hands are the most available parts for routine examination in large numbers of cases. This anatomic relation has been substantiated by Prof. Pryor, of Lexington, Ky. In connection with this a criticism as to the occasional difference in the development of the two hands has been made, but Pryor has stated, after an extensive study of the development of the epiphyses, that where one difference occurs very many points of similarity exist, showing the uniform development not only of the hands, but of all the epiphyses. We can say, therefore, that the hands and wrists can practically be used as a fairly safe guide of epiphyseal development.

Before speaking of the practical use which can be made of the series of representative stages of development, which I am suggesting for the purpose of simplifying the question of labor, it will be well to mention in review certain anatomic facts. These facts, which I have deduced from my own work on about 600 cases, have been substantiated by a number of other observers. As a rule no centers of ossification of the carpal bones or of the epiphyses of the radius, ulna, metacarpal bones, or phalanges are present at birth, but there is a progressive appearance of these ossific centers from birth to the completion of development. While the appearance in succession and the development of the carpal bones and the epiphyses of the radius and ulna, with the epiphyses of the metacarpal bones and phalanges as controls, best provide a developmental series for the first 12 or 13 years of life, the different degrees of ossification up to complete union of the epiphyses of the radius, ulna, metacarpal bones, and phalanges provide the most practical series for grading through adolescence to adult development. We have, therefore, two distinct groups of stages of development which we can use for the grading of human beings from birth to adult life.

In the first group the following order of appearance is met with normally in a large majority of cases, but it is to be noted that it is not only the appearance of the bones which represents progressive growth, but also their increase in size and their massing. The os magnum appears first, then the unciform, then the epiphysis of the radius, then the cuneiform, and then the semilunar. The order of the appearance of the next ossific centers differs without being necessarily abnormal and, in fact, it is probable that it is the number of ossific centers present rather than special ones which indicate advancing development. Thus, while in my series of cases the trapezium or the scaphoid appears next, followed by the trapezoid, Pryor finds that there is some variation in the appearance of the scaphoid, trapezoid, and trapezium, but that usually the trapezoid comes before the trapezium. We can say, however, that after the semilunar the scaphoid comes and then either the trapezoid or trapezium, one following the other. After these eight ossific centers comes the epiphysis of the ulna. There is then for a considerable period an enlarging of the epiphyses and an enlarging and massing of the carpal bones and finally the pisiform bone appears.

It is well to state here that we must take into account in arriving at conclusions as to grades of development of the epiphyses that careful investigation should be made as to whether the hands and wrists have at any time been affected by articular congestion which might produce abnormal conditions of size and appearance.

The following pictures (Pls. A to P) of a series of my cases illustrate the first group. It should be understood that these pictures represent stages of anatomic development and, although I have indicated the age and sex for future reference, that these chronologic ages are incidental. Pryor's table, which will appear later, can be used as a basis for further study of chronologic age as corresponding to anatomic age.

Although in many cases mere age does not indicate development, yet Pryor's table, which corresponds to my own observations, gives useful information of a great deal of practical value.

Pryor's table.—Development of the wrist according to sex.

Sex.	Age in years.	
Female.....	½	A. Magnum, unciform.
Male.......	1	
Female.....	1½	B. Magnum, unciform, radius (lower epiphysis).
Male.......	2	
Female.....	2½	C. Magnum, unciform, radius, cuneiform.
Male.......	3¼	
Female.....	3½	D. Magnum, unciform, radius, cuneiform, semilunar.
Male.......	4¼	
Female.....	4¼	E. Magnum, unciform, radius, cuneiform, semilunar, and one of the following: Scaphoid, trapezoid, trapezium.
Male.......	5¼	
Female.....	4¾	F. Magnum, unciform, radius, cuneiform, semilunar, and two of the following: Scaphoid, trapezoid, trapezium.
Male.......	5¾	
Female.....	5¼	G. Magnum, unciform, radius, cuneiform, semilunar, scaphoid, trapezoid, trapezium.
Male.......	6¾	
Female.....	6¼	H. Magnum, unciform, radius, cuneiform, semilunar, scaphoid, trapezoid, trapezium, ulna (lower epiphysis).
Male.......	7¼	
Female.....	7½	I. Same as H, but more advanced.
Male.......	9	
Female.....	8½	J. Same as I, but more advanced.
Male.......	10	
Female.....	10¼	K. Magnum, unciform, radius, cuneiform, semilunar, scaphoid, trapezoid, trapezium, ulna, pisiform.
Male.......	12¾	

We now come to the second group, the earlier stages of which can be used to aid us in determining whether the individual has arrived at a period of development when he will not be harmed by beginning to work. The latter stages of this group can be used in determining the fitness of an individual for different degrees of work represented by vocation. Here, in accordance with the rule that the later the appearance of an epiphysis the earlier the union, we must remember that the rule for union is, first, the epiphyses of the distal phalanges, then those of the metacarpals, then those of the other phalanges, then the epiphysis of the ulna, and finally that of the radius. It is thus seen that the changes in the ossification of the epiphysis of the radius play the most important rôle in the second group as, appearing first, it unites last, showing progressive changes up to adult development.

It will take much further investigation and careful study of a large number of cases in order to determine the progressive stages of development in the second group to the degree that has been done in the first group, where the successive stages are much more simple. The fact, however, remains that a knowledge of the different stages of development in the second group is of importance in a preliminary examination. My observations in this group have been too few to warrant my giving them as a standard, but for the purpose of aiding future investigators, I give here Prof. Pryor's conclusions as to the times of union of the epiphyses of the wrist and hand:

Union of epiphyses (Pryor).

Lower epiphysis of radius:
  Female, 17 to 18 years
  Male, 20 to 21 years

Lower epiphysis of ulna:
  Female, 16 to 17 years.
  Male, 19 to 20 years.
Epiphyses of the metacarpal bones:
  Female, 15 to 16 years.
  Male, 17 to 18 years.
Epiphyses of the phalanges:
  Female, 15 to 16 years.
  Male, 17 to 18 years.

The distal epiphyses unite first, next the metacarpal, then those of the first row of phalanges, and then those of the second row of phalanges.

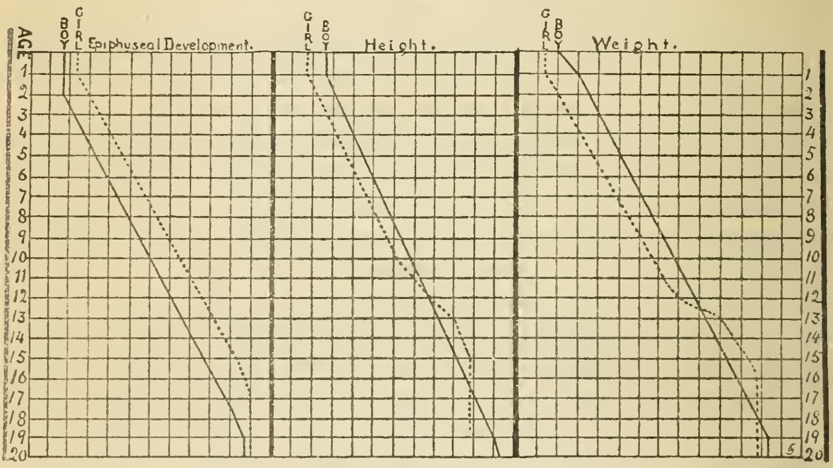
The following pictures are illustrative of certain grades of development in the second group, irrespective of age, and presupposing that intermediate grades of development can be introduced when further study warrants such addition:

In connection with a Roentgen examination of an individual, it should be borne in mind that while boys are usually heavier and taller at birth than are girls, at the period of puberty the girl overtakes, in height and weight, the boy of the same age. She surpasses him and becomes a developed woman before the boy becomes a man, when he, in turn, overtakes and surpasses the woman. It is, of course, well known that these periods of growth vary in the individual according to zone, race, and environment.

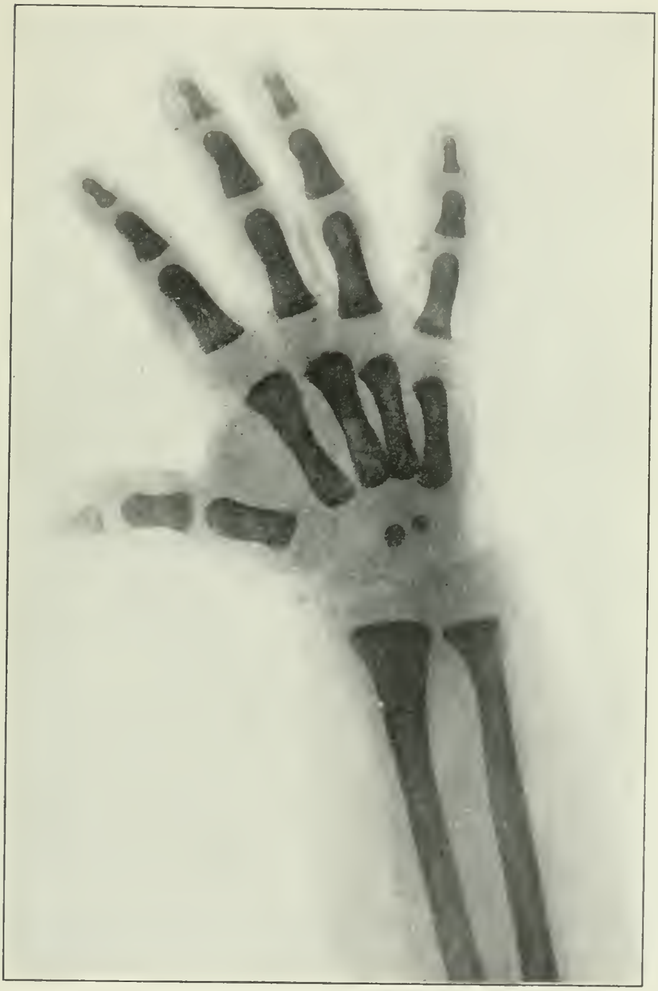
The following chart, without attempting to illustrate the finer details of weight and height in pounds and feet, shows how the lines, representing the weight and height of boys and girls, cross each other. These lines are shown so well by Camerer that I have taken his charts as illustrative and to compare with my own chart of epiphyseal development. The girl's growth is shown by a broken and the boy's by an unbroken line. The girl's weight line is seen to cross the boy's at about the 13th year, and the boy's to cross the girl's at about the 17th year. The lines of height show about the same relation as do those of weight. On examining the lines which represent epiphyseal development, it will be noted that such development in girls is, from the very first year of life, in advance of that of boys, and remains ahead up to the time when the epiphysis of the radius becomes fully united, thus being in striking contrast to the lines of weight and height. This union, according to Pryor, takes place at about the 17th or 18th year in females and at about the 20th or 21st year in males, thus showing that, anatomically, the girl becomes a mature woman earlier than the boy becomes a man. These lines emphasize the lack of correlation between epiphyseal growth and general physical development.

It would seem, therefore, that in grading individuals from birth to the completion of development, the epiphyseal development should play a prominent part; also that the individual's general welfare depends to a certain degree on keeping its mental and epiphyseal development in equilibrium, thus avoiding overstrain, whether mental or physical. This difference in development also suggests that, in grading the two sexes, we should have either a separate curriculum for the sexes, or one curriculum adapted to certain stages of epiphyseal and mental development for both sexes.

This advanced development of the girl is strikingly shown in the case of twins, where the epiphyseal and carpal development is similar when the twins are of the same sex, but dissimilar when the twins are of opposite sex. Plates I and II show the similarity in development of the hands of twin girls. Plates III and IV show the advanced development of the girl in the hands of twins, a boy and a girl.

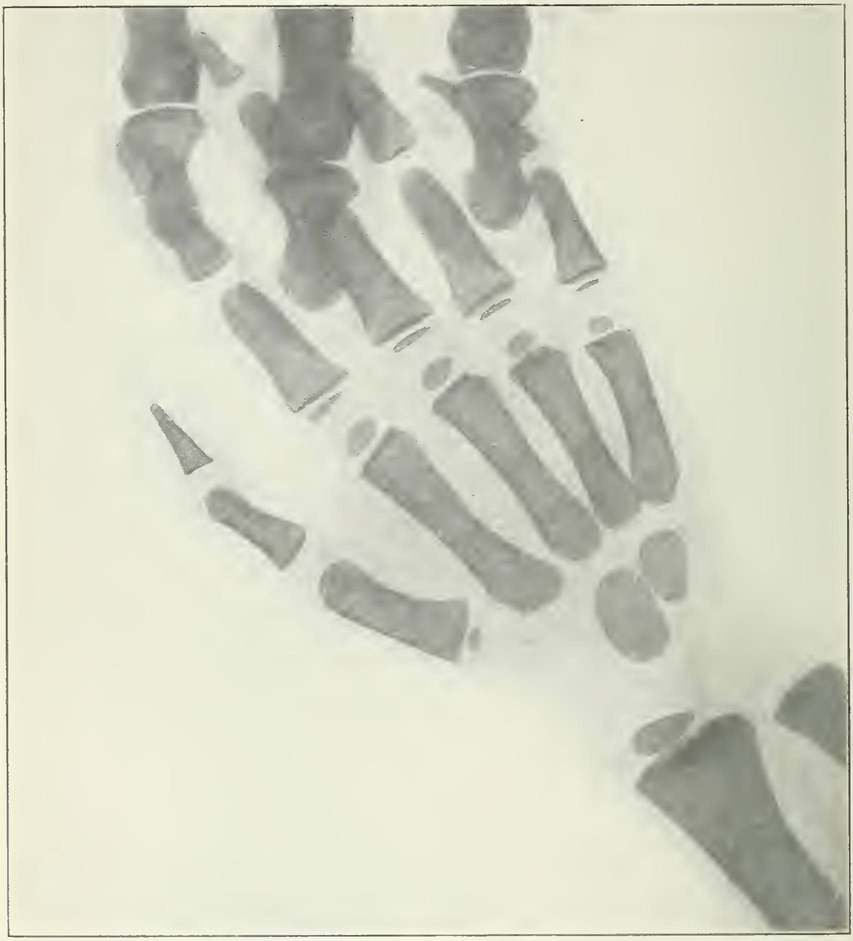


The following are some illustrative examples of the use of the Roentgen method of examination in connection with labor: Plates V and VI, given to me by Prof. Pryor, represent the hands of two young men of 17 years. Plate V shows a lack of ossification of the epiphyses of the radius, ulna, metacarpal bones, and phalanges, so marked and corresponding more to the later stages of the first group, that we are at once warned that he should be examined and graded with unusual care as to his work, in order to protect him from loss of valuable time in his vocation. He should not be allowed to undertake the higher grades of labor, which are liable to break him down, before he is ready to undertake them with safety. This young man should normally show a greater degree of ossification of the radius and ulna and, according to Pryor, union should have taken place in the epiphyses of the metacarpal bones and phalanges. Plate VI, on the contrary, shows such complete union of the epiphyses of the metacarpal bones and phalanges, as well as those of the radius and



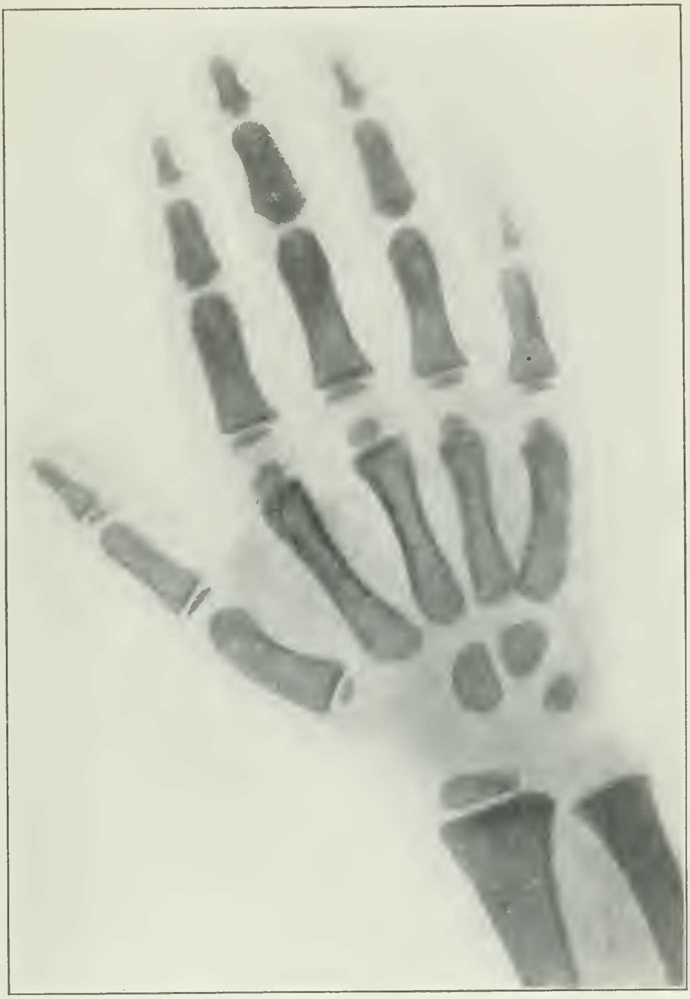
GIRL, AGED 6 MONTHS.

PLATE B



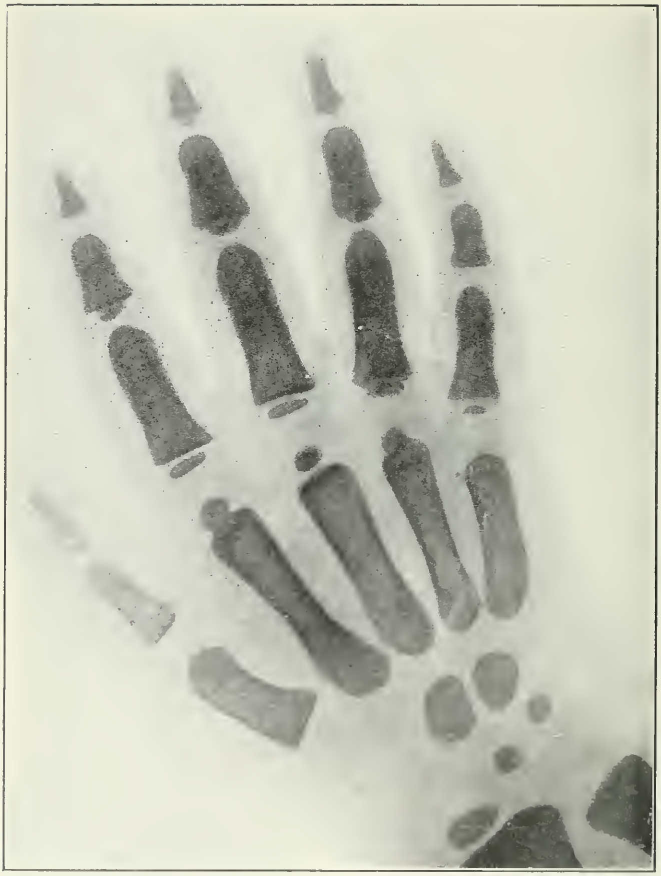
GIRL, AGED 2¾ YEARS.

PLATE C

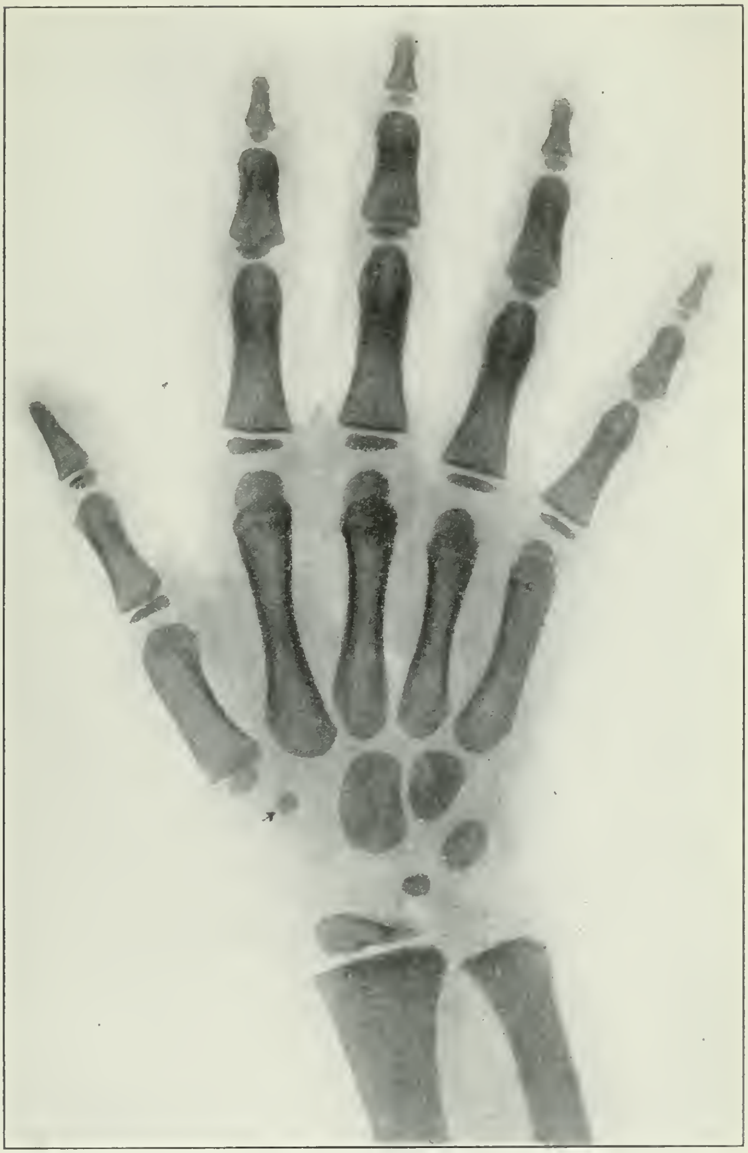


GIRL, AGED 3¾ YEARS.

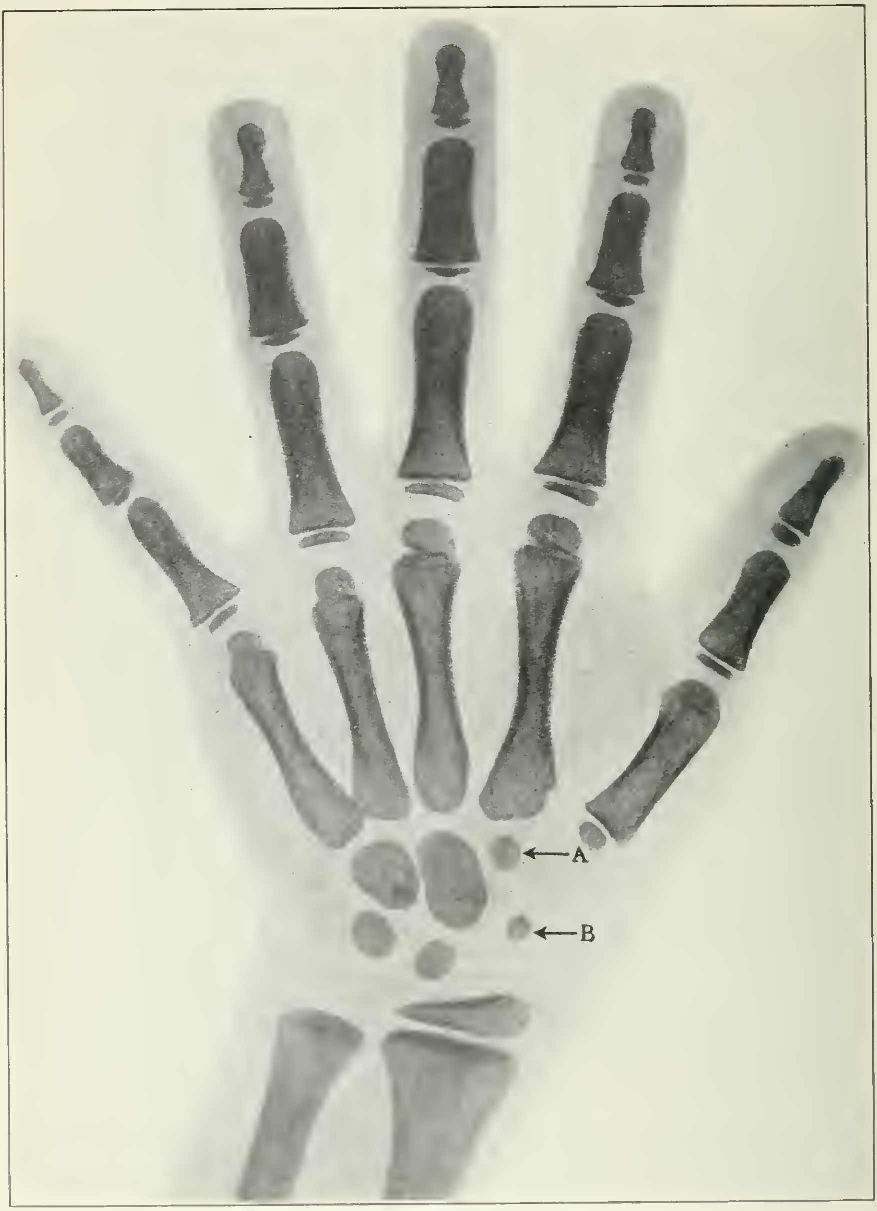
PLATE D



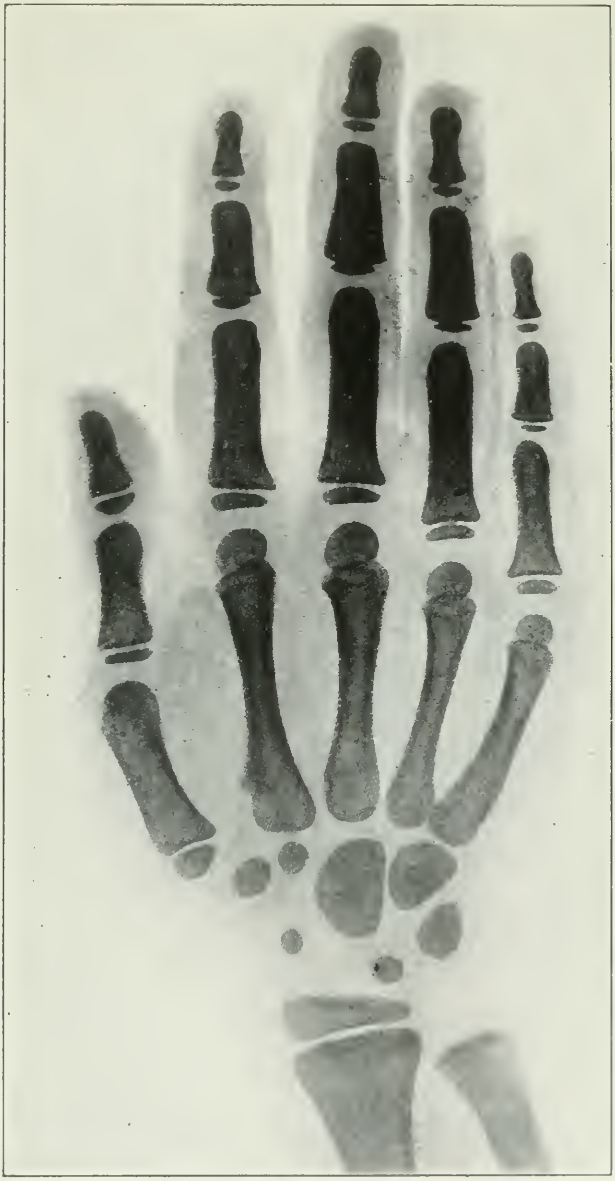
BOY, AGED 2¼ YEARS.



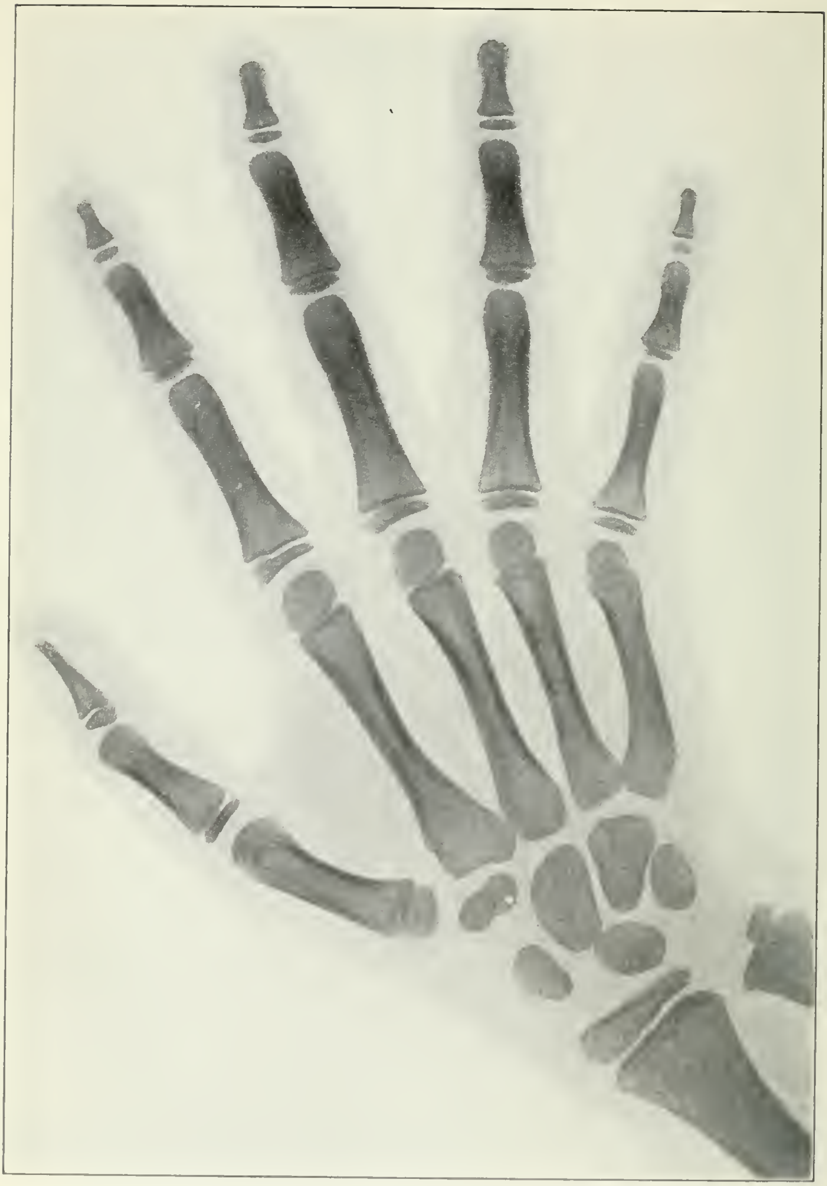
GIRL, AGED 3½ YEARS.



GIRL, AGED 5½ YEARS.

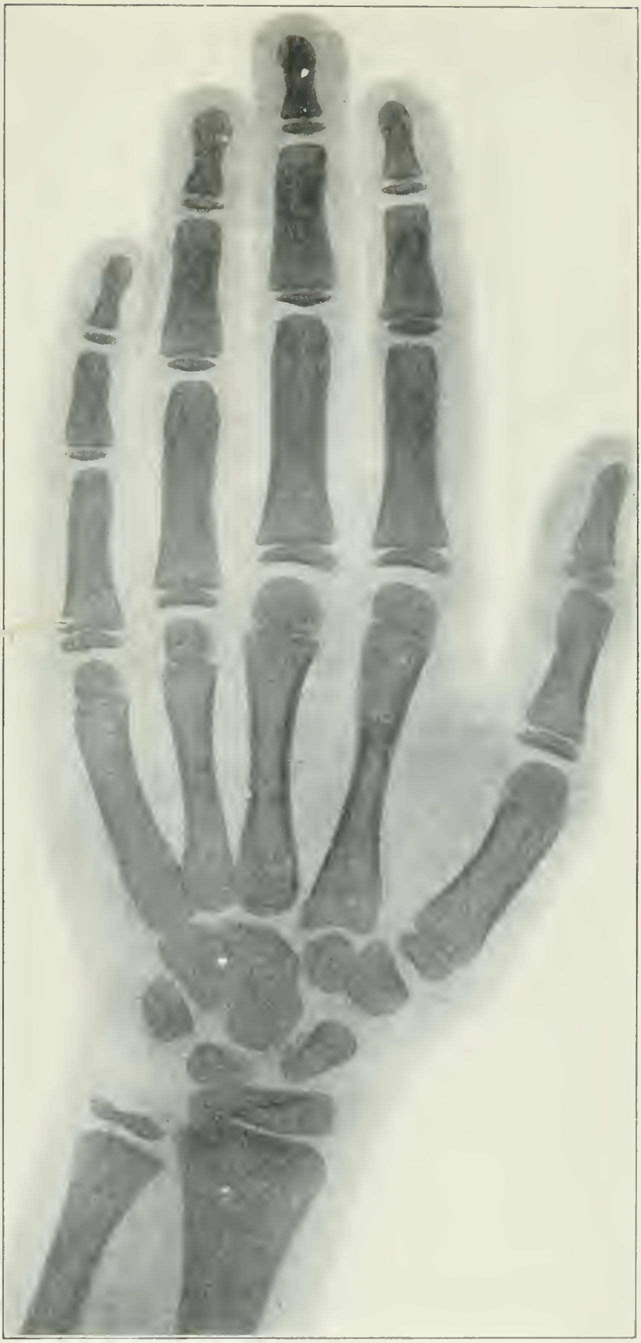


GIRL, AGED 6½ YEARS.



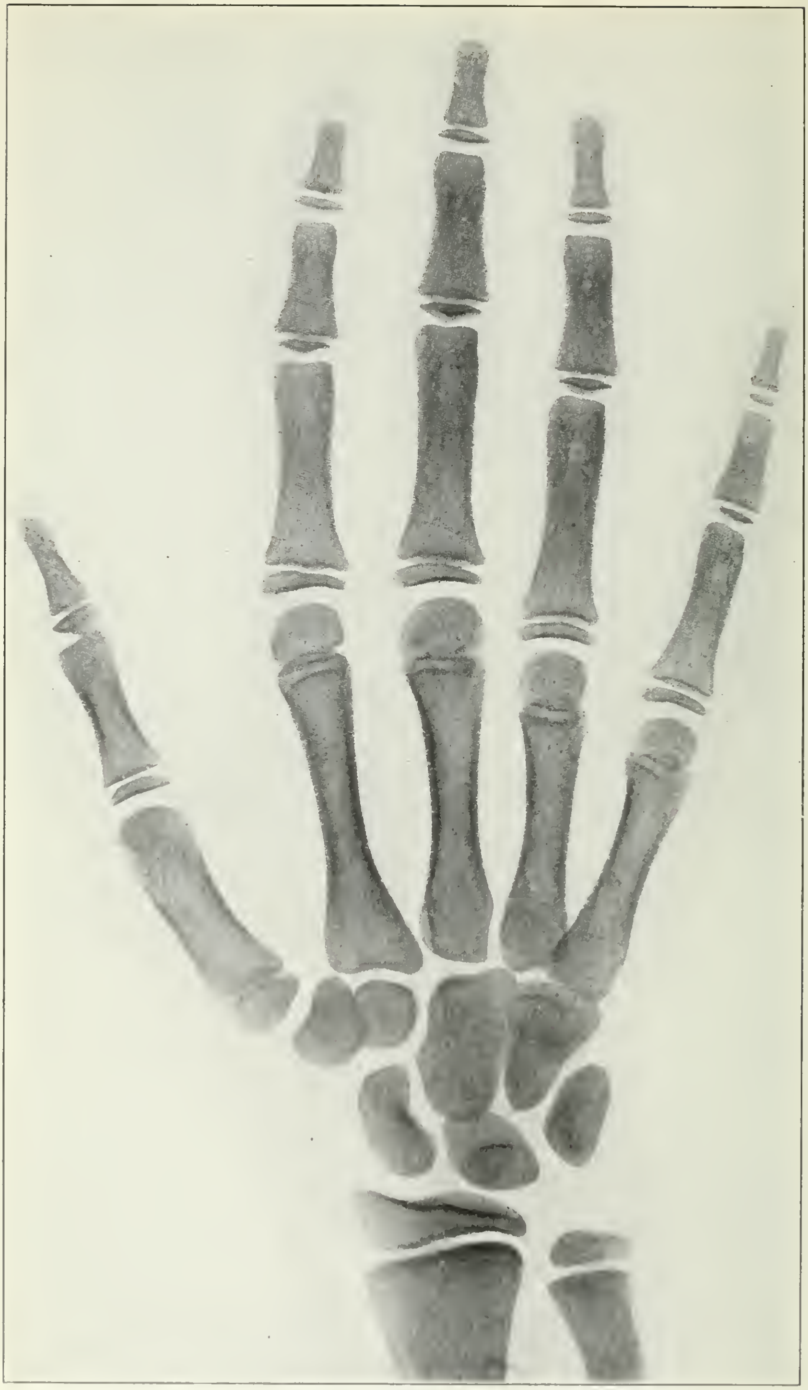
GIRL, AGED 6 YEARS.

PLATE I

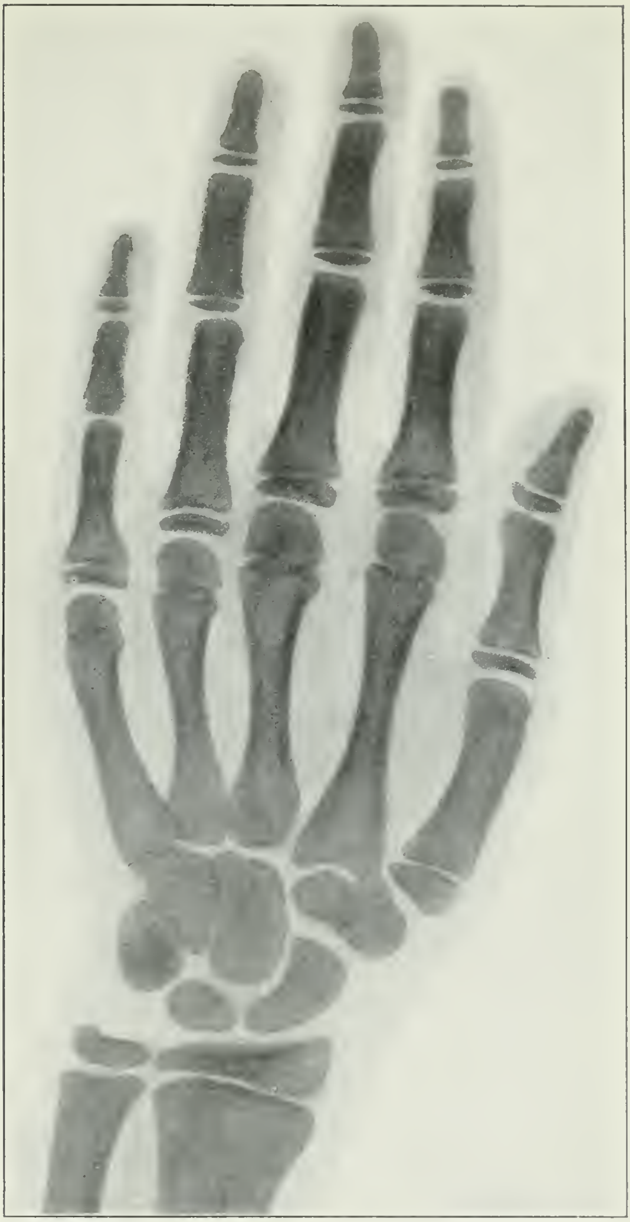


GIRL, AGED 6¾ YEARS.

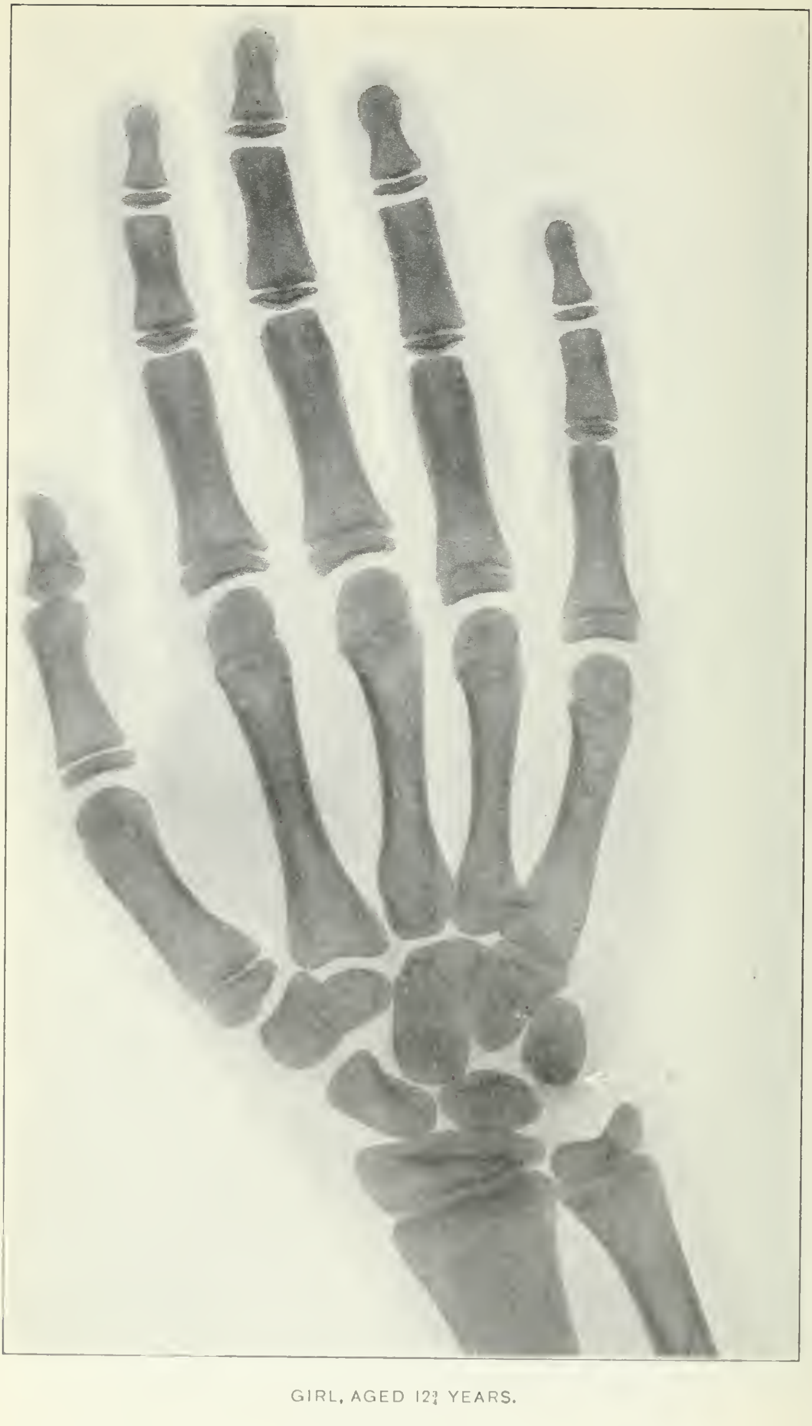
PLATE J



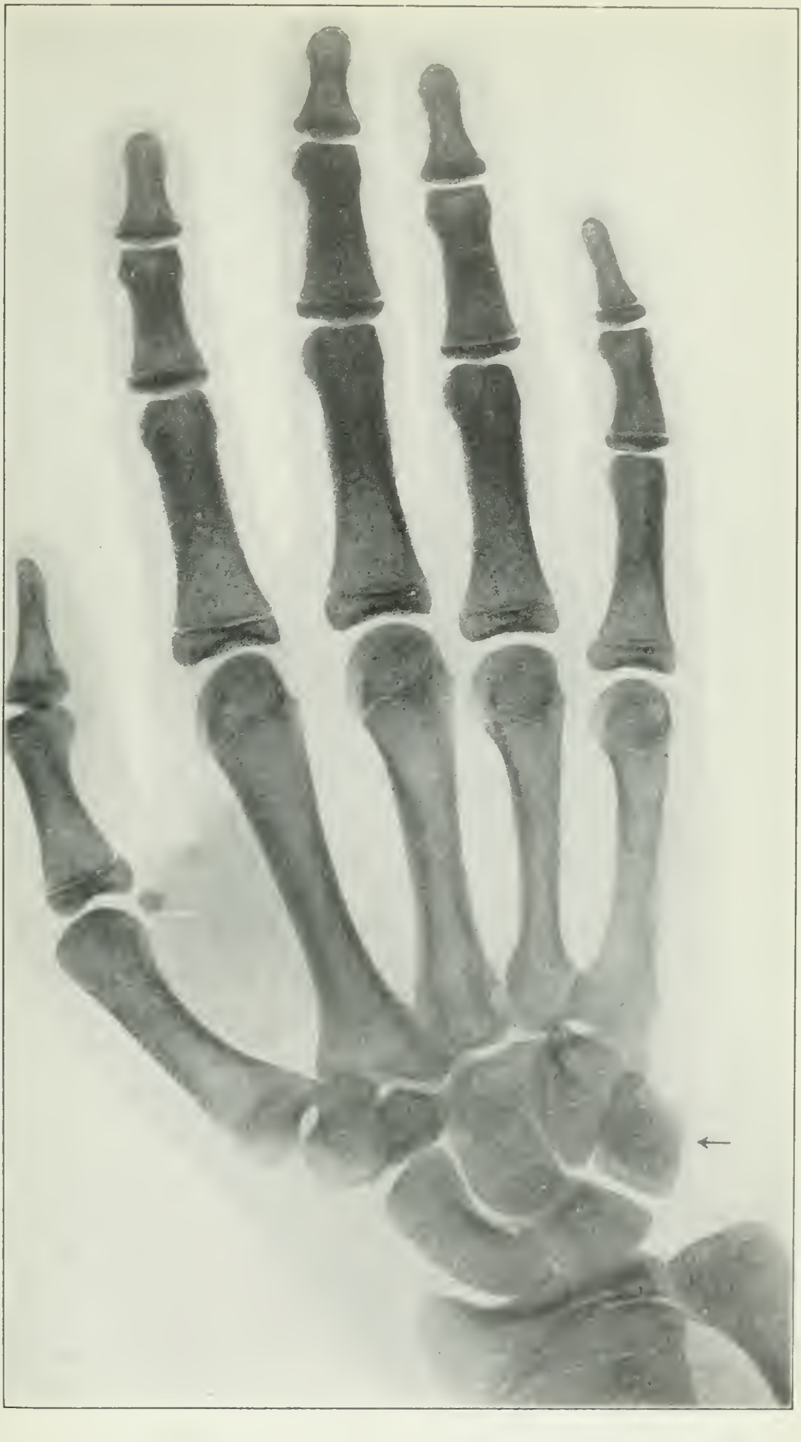
GIRL, AGED 8¼ YEARS.



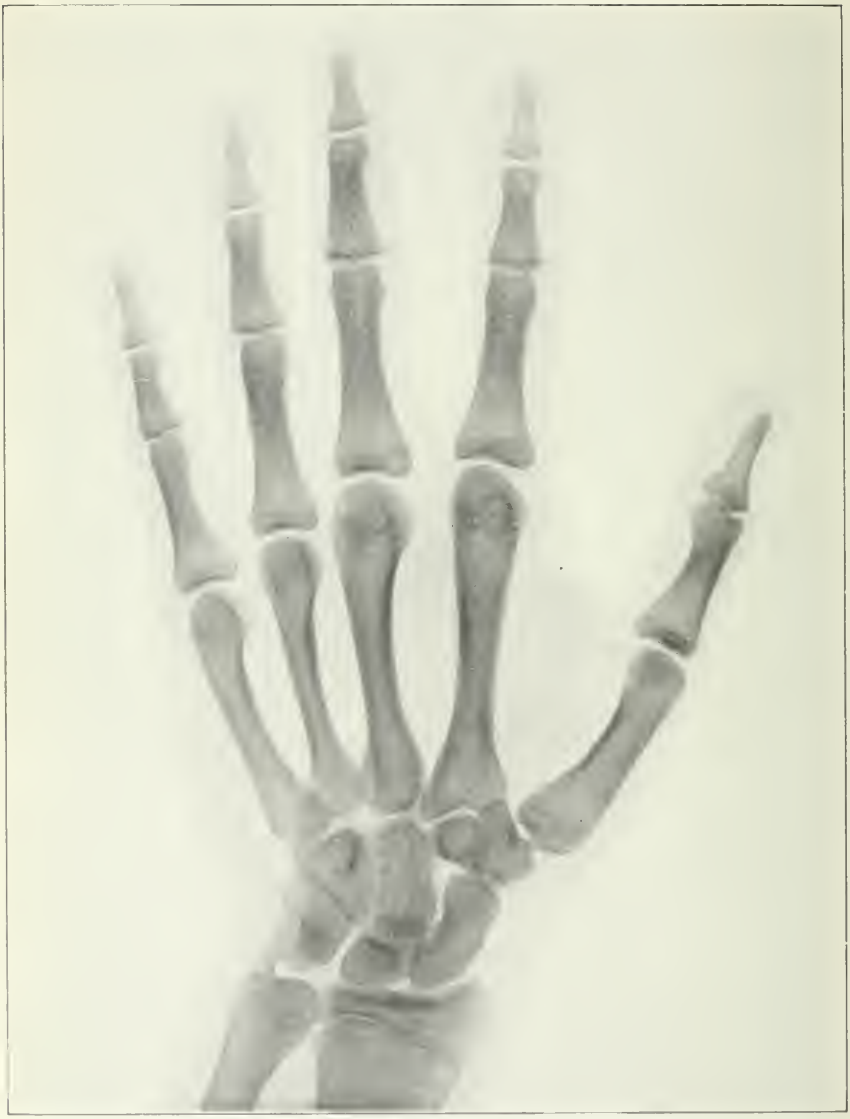
GIRL, AGED 11½ YEARS.



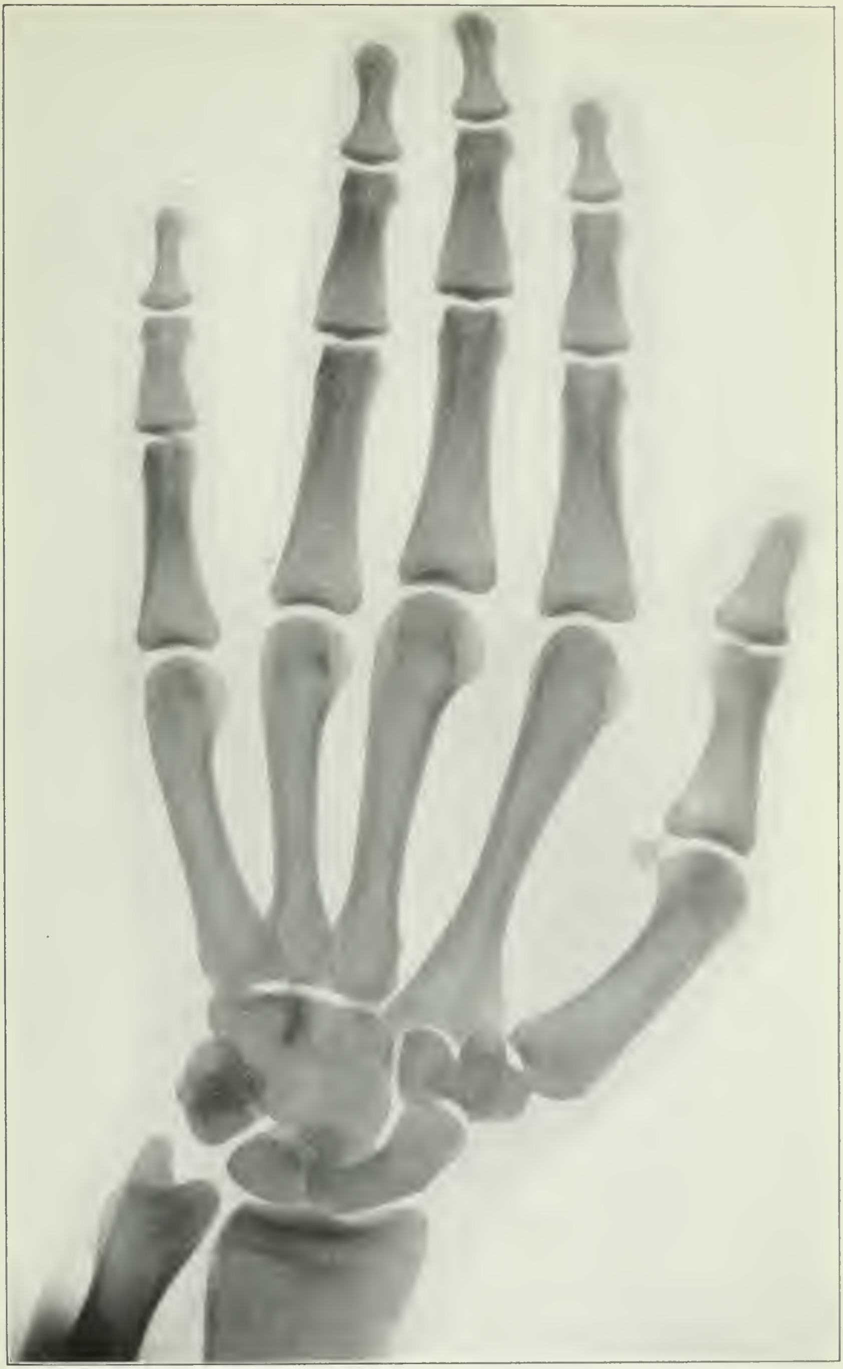
GIRL, AGED 12¾ YEARS.



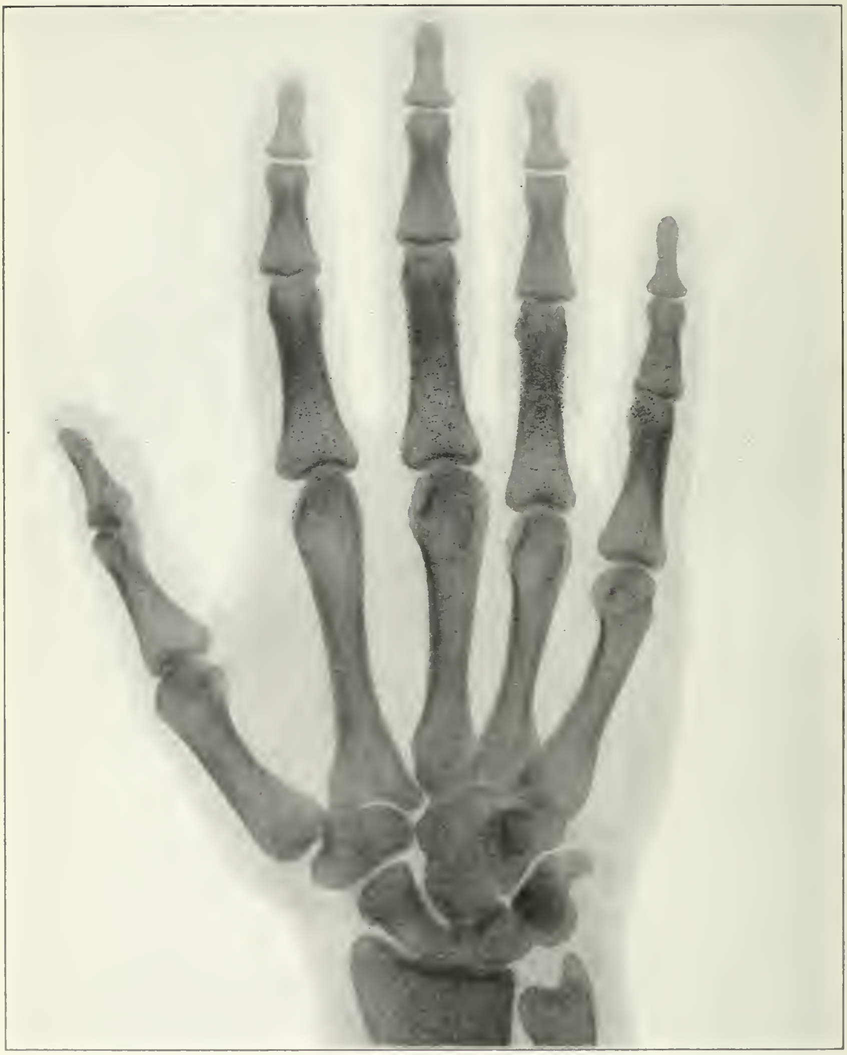
BOY, AGED 13½ YEARS.



MALE, AGED 14½ YEARS. OSSIFICATION OF RADIUS BEGUN.

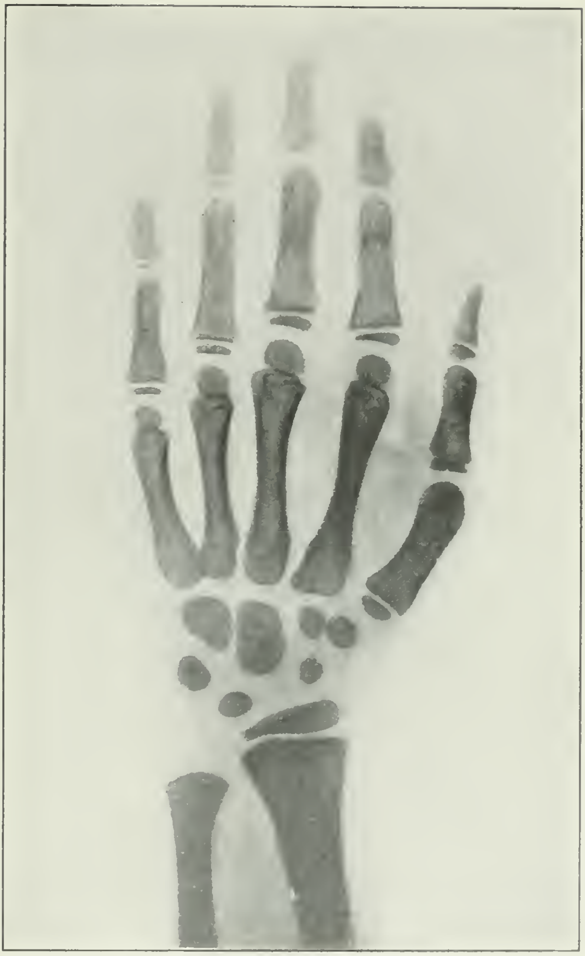


MALE AGED 18 YEARS. OSSIFICATION OF RADIUS ADVANCED.



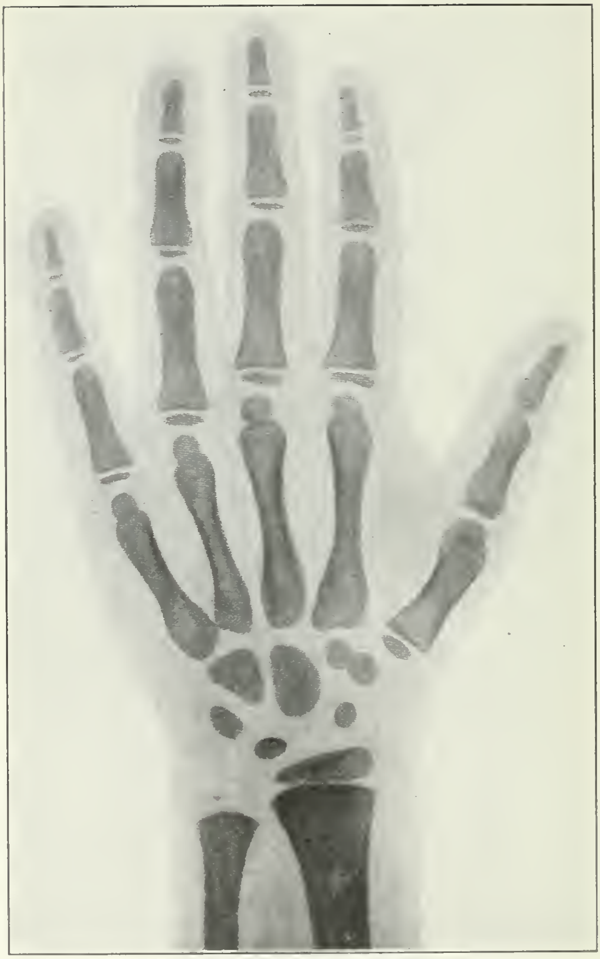
MALE, AGED 19 YEARS. OSSIFICATION OF RADIUS ABOUT COMPLETED.

PLATE I

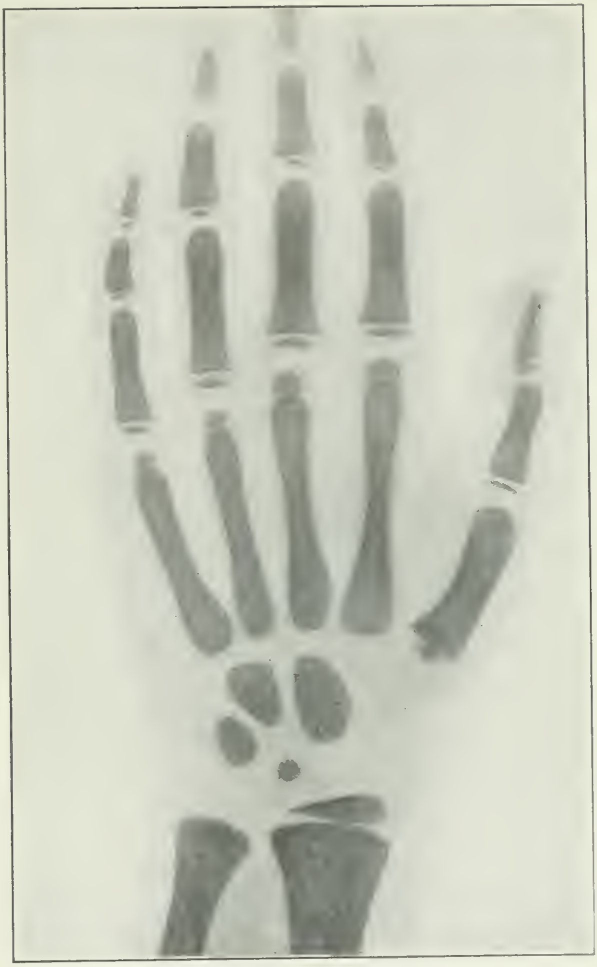


GIRL, AGED 6 YEARS AND 7 MONTHS. TWIN SISTER OF GIRL, PLATE II.

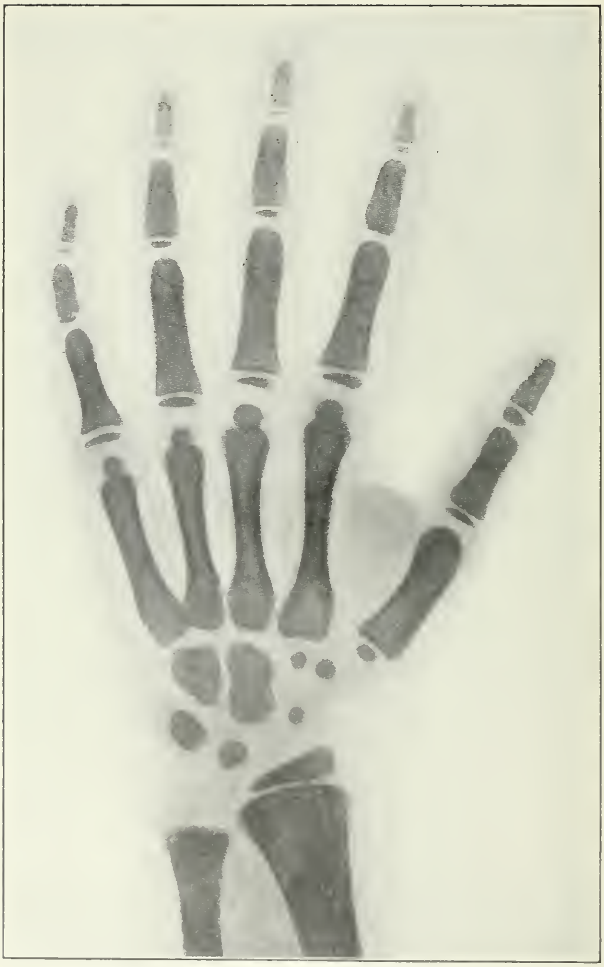
PLATE II



GIRL, AGED 6 YEARS AND 7 MONTHS. TWIN SISTER OF GIRL, PLATE I.

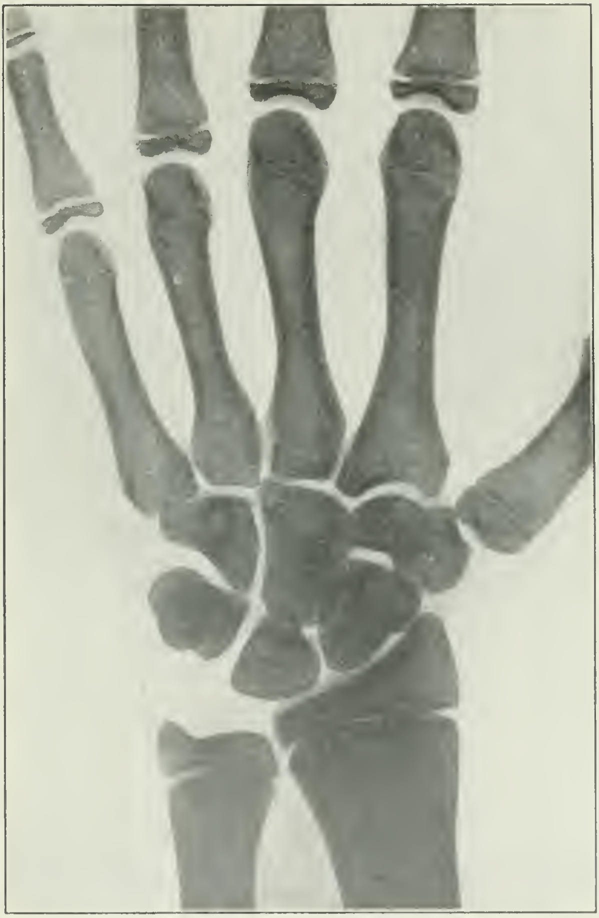


BOY, AGED 5 YEARS AND 3 WEEKS. TWIN BROTHER OF GIRL, PLATE IV.



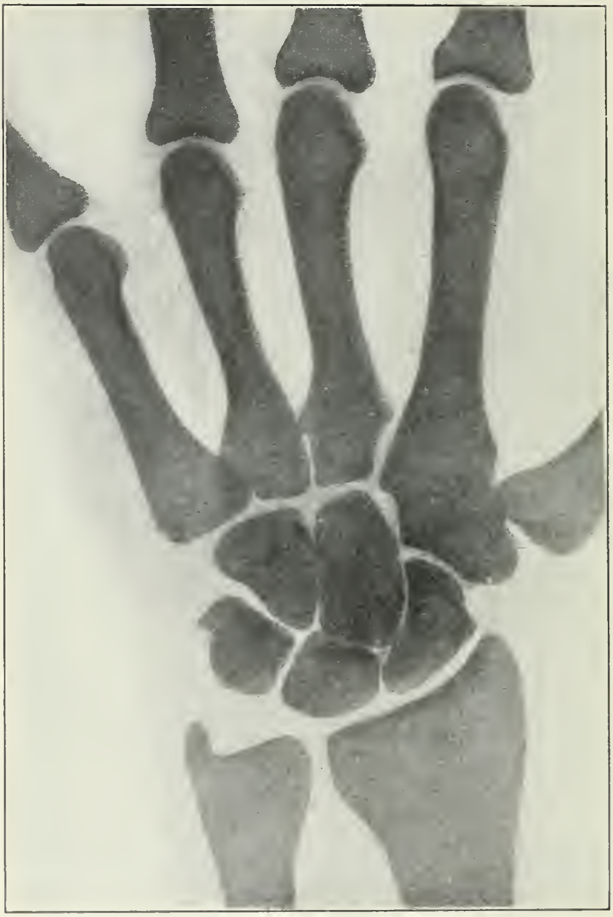
GIRL, AGED 5 YEARS AND 3 WEEKS. TWIN SISTER OF BOY, PLATE III.

PLATE V



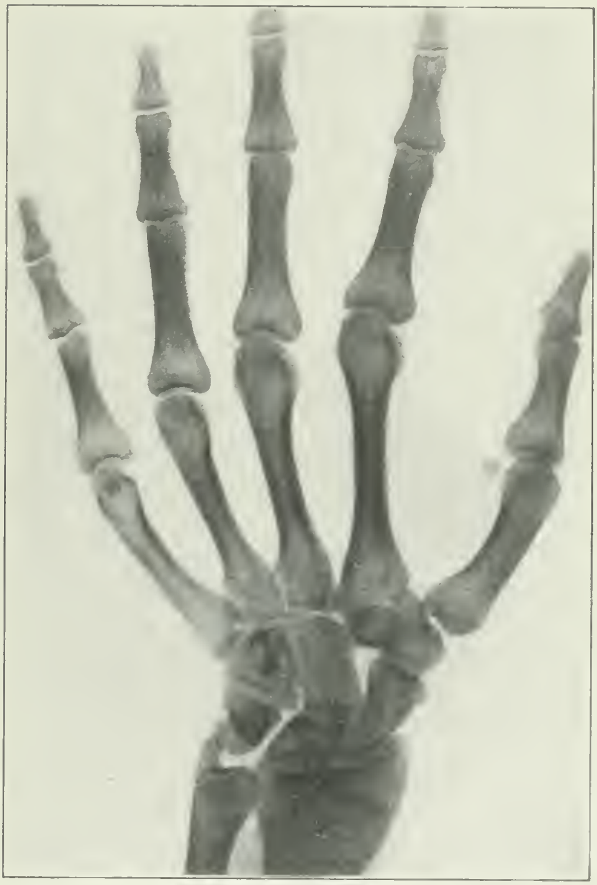
MALE, AGED 17 YEARS AND 7 MONTHS.

PLATE VI



MALE AGED 17 YEARS AND 2 MONTHS.

PLATE VII



MALE, AGED 15 YEARS.

ulna, that he at once suggests fitness for adult labor, and if the other examinations, mental and physical, are satisfactory, little apprehension need be entertained as to physical overstrain.

Plate VII represents the hand of a young man who entered college with honors at 11 years. He had no difficulty in keeping up with his classmates of 18 or 19 years and was graduated with a cum laude. When seen by me at 15 years, he was taking an advanced course with men 22 and 23 years of age, and showed no mental fatigue. His anatomic development shows a very advanced stage of ossification, and, although an unusual case, he illustrates the general principle of grading an individual according to his mental and physical condition, rather than according to his age. With his mental and physical development in equilibrium, he has been provided by nature with an equipment so far above that of the average boy of his age that he has a right to be benefited by advantage of time in his vocation. It would seem that he should not be prevented by an arbitrary law of age from entering upon some such career as, for instance, that offered at the United States Naval Academy, from which he would be excluded on account of his age, 15 years. The minimum age limit at the academy is 16 years. This advanced stage of development will be seen in the plate, which shows union of all the other epiphyses, and almost complete union of the epiphyses of the radius and ulna.

It may be said here that a routine Roentgen examination of the wrists and hands is now being made as a part of the general physical examination at the United States Naval Academy at Annapolis.

Teachers and those who regulate the grading of individuals in connection with labor should have it impressed upon them that the Roentgen method of examination is not so difficult and complicated as may at first appear. They should be made to understand that the use of the Roentgen ray in this connection is not the introduction of an exact method, but that it is an aid, and a valuable one, in determining how an individual should be graded.

The details of when and where these pictures should be taken would have to be decided upon by practical people who are recognized as organizers. It should be understood that the pictures can be taken in a few seconds and, when the details are once systematized, much more rapidly than can be accomplished in ordinary photography. Central places, which could be used for quite large areas of habitation, should be determined upon as fit for the installation of a Roentgen-ray machine. A large number would not be necessary, and the expense would not be very great. The space required for such a machine is small, and could be obtained in any of the schoolhouses or public buildings. It would not require an especially expert Roentgenographer to determine the number of carpal bones or the general degree of ossification of the epiphyses. Anyone who could take a moderately good Roentgen picture would be able to determine this at once.

Prints of the hands of each individual should be taken from time to time and kept on file with the other records of examination. By comparing earlier and later pictures and by observing any changes or lack of changes information would be obtained as to whether an individual is developing or not. What the Roentgen picture really does is to put the examiner on the right track by pointing out to him the different degrees of anatomic development, thus quickly directing his attention to the proper grading of the individual. I would again emphasize the principle that the mental and physical development should be kept as nearly as possible in equilibrium, it being the correspondence of the two which will best fit the individual for his special vocation.

Finally, we must not be misled by thinking that the development of the epiphyses always represents the actual, general, physical strength. The muscles may be weak, but such a condition should be considered abnormal, and the individual should be treated as abnormal and should not be classified by the degree of strength which he shows. On the other hand, the carpal bones and the epiphyses of the radius, ulna, metacarpal bones, and phalanges indicate what the development really is and has been, and the muscular strength and endurance should be worked up to the degree of development shown by the anatomic condition present.

SUMMARY.

1. Chronologic age and physical condition do not necessarily correspond.
2. The individual should be graded according to his physical and mental conditions and not according to his chronologic age alone.
3. A valuable aid as a basis for determining the physical condition is the anatomic development.
4. A study of anatomic conditions shows that the hands and wrists present progressive stages of development from birth to the completion of ossification and correspond in their development to the rest of the skeleton.
5. A further study shows that these stages of development can be divided into two groups, one in a general way corresponding to the elementary school period and the other covering more advanced school periods and those of labor and vocation.
6. Labor and vocation should be graded, and the individual should be allowed to undertake the grade of labor, as well as the degree of mental work, to which he is best adapted.
7. In order to get the best results in the grading of human beings, the mental and physical conditions of the individual should be kept in equilibrium.

FRIDAY MORNING, SEPTEMBER 27, 1912.

THE EFFECTS OF MONOTONOUS TOIL IN THE YEARS PRECEDING ADOLESCENCE.

MARGARET MCMILLAN, member of the school board, Bradford, England, manager (schools) London County Council.

Before speaking of the effect of monotonous toil in the years preceding adolescence one must make some allusion to that interesting period of life—so short as to be imperceptible and perhaps nonexistent as yet in some races, but prolonged in the white children of the West over a period of years. It is fitting that America, the New World, should have produced thinkers devoted to the study of this latest period of human growth. How thrilling its problems are, how new and charged with fate, these teachers have set forth already in their writings. If no further allusion is made to such workers as Stanley Hall, that is because we are concerned with a lesser problem—the effect of monotonous toil in the years preceding adolescence.

Though the years just before adolescence have characteristics of their own, yet parallels to the events of every period of life may be traced in earlier stages. The conscious life of a young child, for example, is concerned with the functioning of nerve cells that later will act automatically. The rapid progress he makes does not veil, but rather makes plain, the fact that a travail of adaptation is going on and that the stress and voluntary effort of later years has its parallel in infancy. Swiftly as we pass through these earlier crises in growth and impossible as it is to describe them accurately, there is little doubt that we may trace in them the beginning of conscious effort.

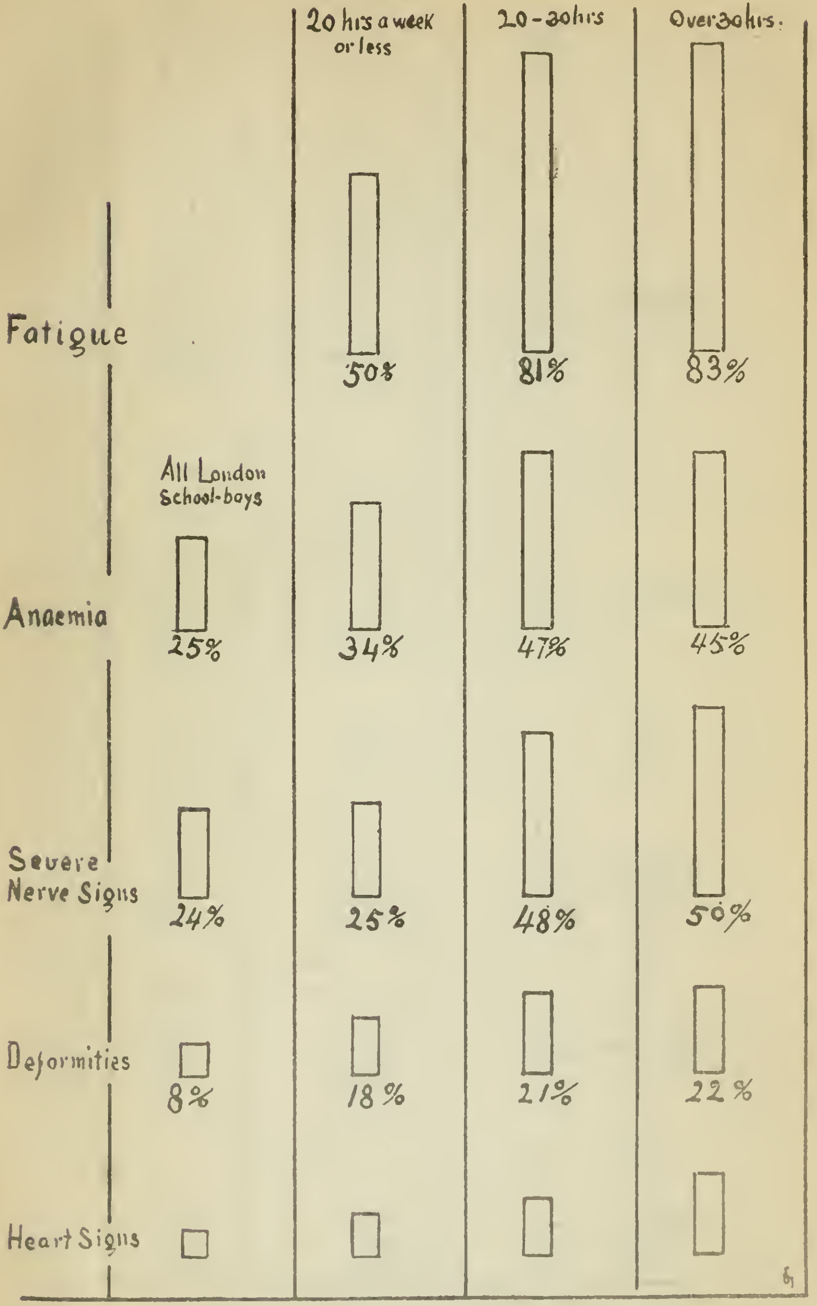
Monotony at this early age would be fatal—so fatal as to render humanity itself impossible. The young child is guarded from it in many ways. To begin with, he is greedy for sensation, and seeks for it in all his waking hours. Then he is not only born into a new and virgin world, whose commonest objects awaken and satisfy his craving for new experience. He is born into a civilization which multiplies on all hands the appeal of the physical world, and even creates new worlds with manifold appeals and power of expression. Last, but not least, the young child's weakness safeguards him. He can not be set to monotonous work in his infancy. In England it was found necessary to wait, even in the darkest days of child labor, till he was 4 years old before thrusting him into the factory. I do not say that the infant of 3 or 4 years old is always completely safeguarded even now. In the worst quarters of our slums, and rarely in other places, one may yet see babies who suffer from monotony.

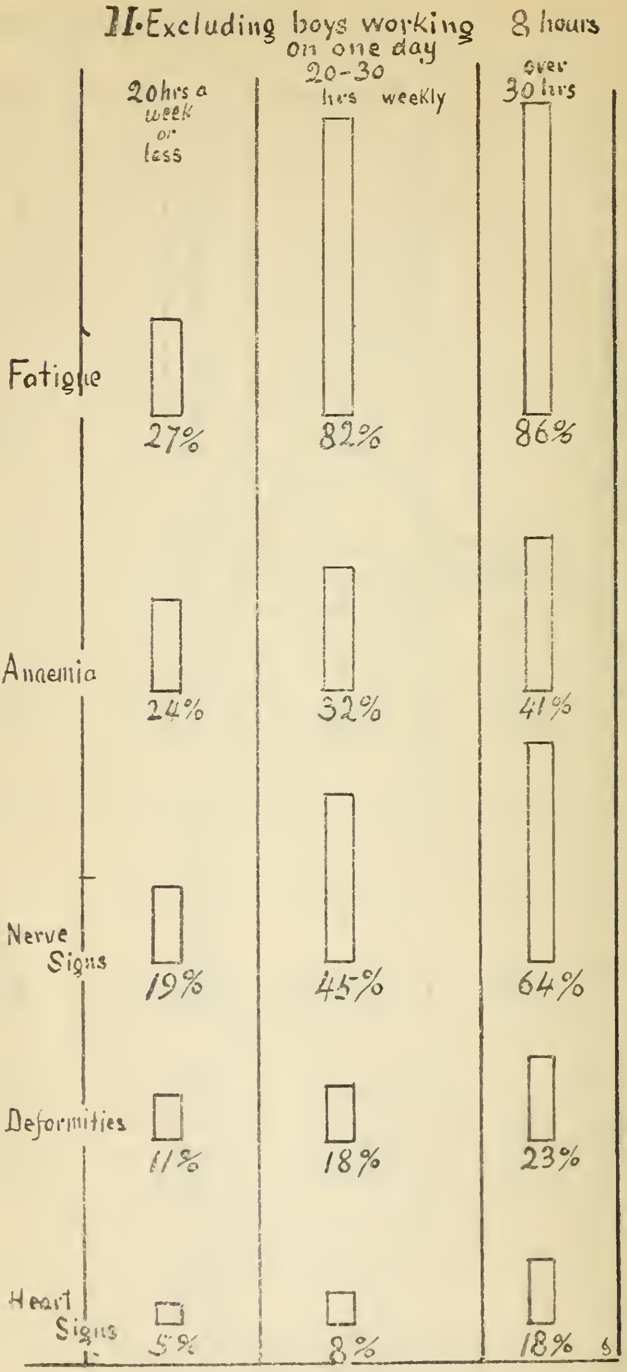
They are locked into rooms all day while mothers are out working or given into the charge of persons who condemn them, in waking hours, to lethargy. This happily is rare. Monotony in infancy constitutes a denial of the conditions that make humanity possible. If one wishes to learn what infancy owes to civilization, one has but to remember the poor lad, known to history as the " Savage of Aveyron," dependent for stimuli almost from babyhood on the changes of the weather, unable to develop as a human being even the basal senses of touch, taste, and smell, or to establish those associations by means of which the mechanism of emotional expression or relief is evolved. Neither snuff nor sorrow could make him shed tears. Yet he was not a congenital idiot, or even a defective, but a human being, arrested on the threshold of childhood. It is a thrilling chapter in psychology, which tells how, through the application of powerful stimulants to the skin, the lowlier senses of touch, taste, and smell were refined and developed in him, and how this development had not only a specific but a general effect on the whole nervous system, lifting the unfortunate lad forward, as it were, into a new life! It is a little strange, is it not, that educationists have not even yet realized the meaning of these very suggestive facts. We have no savages of Aveyron in our schools to-day. Creatures arrested in their human development are not captured in our woods. Yet in every one of our great cities, and in rural areas as well, we have tens of thousands of children whose condition does in some respects (though with great modifications) resemble that of the boy of Aveyron, and who, living in the midst of a high civilization, are allowed to share only a very small part of its riches and blessings. The development of even the lowliest senses is so inadequate for tens of thousands that the attainment of normal mentality is jeopardized. Let me give illustration from experience:

The system of medical inspection of school children had not been many weeks in operation in England when it became clear that mere records and statistics, valuable and necessary in themselves, had no immediate value, save in so far as they might lead people to look for a remedy. School clinics, or, as I prefer to call them, health centers, were opened at Bradford, at Bow, and later at Deptford, a crowded district in London, and, as a result of these and their work, in other places. In these centers a dentist, doctors, and nurses are engaged. In the Deptford health center there is, indeed, a large staff of 14 persons. The aim is to differentiate the work once and for all from that of the hospital and to identify it with that of the good home and the school.

During the past year a few experiments were made in the camp, with a view to learning the actual condition of the children.

I. School-boys employed weekly.




II·Excluding boys working 8 hours on one day
20hrs a week or less
20-30 hrs weekly
over 30 hrs
Fatigue
27%
82%
86%
Anaemia
24%
32%
41%
Nerve Signs
19%
45%
64%
Deformities
11%
18%
23%
Heart Signs
5%
8%
18%

It was realized that the development of the oldest senses must have a great effect on the mentality; so one of the first experiments was concerned with them.

On various occasions the eyes of the children (who, be it said, enjoyed the experiment) were bandaged. Various flowers of pungent smell or sweet perfume were given to them. (They came from their own gardens and were familiar to them by sight.) Only one or two children could recognize any flower by smell. It was strange to see a large class sit wonderingly sniffing at the flowers and puzzled to know what this kind of sense impression might be that they were expected to enjoy.

Together with this indifference to scents and smells, there was a rough dry condition of the skin and also great insensibility to heat and cold. It is true that many of the children, swathed in many garments, were afraid of cold: but tests with cold, tepid, hot water showed in nearly every case an amazing insensibility and powerlessness to discern or appreciate differences of temperature. That the defect was not in the sense organs, but in the brain centers not yet educated to discern vast ranges of stimuli, is evident from the fact that all were capable of receiving training.[1]

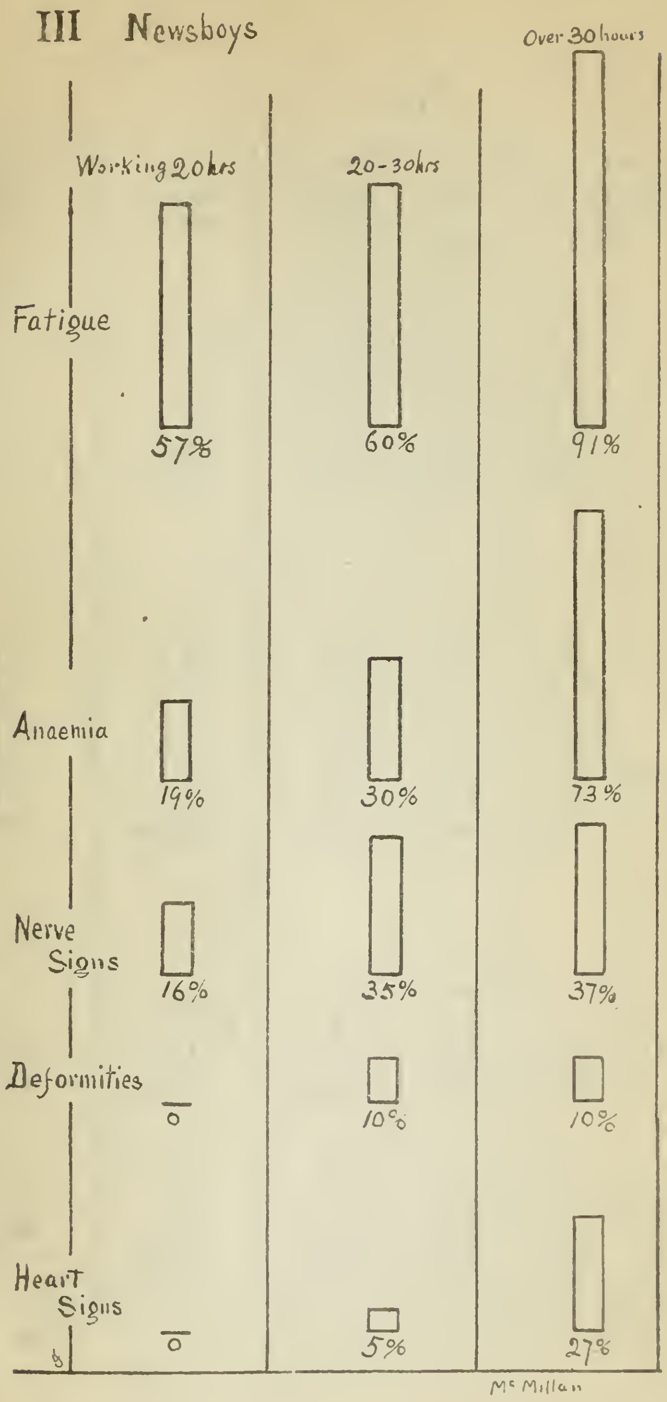
The effect of monotonous occupation in the years before adolescence is very strikingly illustrated through an inquiry made seven years ago by Dr. Thomas, a medical officer of the education committee of the London County Council. Dr. Thomas took several thousands of London children of normal capacity and health from 14 or 15 representative London schools. From the same class of children he examined an equal number who were earning money as newsboys, bakers, and carrier boys, milk boys, nurse girls, messenger boys, and barbers' assistants—all under the age of 14.

The effect of the work was not in every way bad for every order of child worker, but the general effect can not be described as anything but disastrous. For example: It is to be presumed that the newsboys did not suffer in every way, for the percentage of anemic lads among them was lower than among school children. On the other hand, the newsboys showed many symptoms of nervous disturbance, coming out worse than any other group in the column headed "Nerve signs." There was also a rise in the number said to be suffering from "heart disturbance." The inference is that the open-air life had helped them physically but not enough to overcome the evil effects of strain and effort during many hours every day.

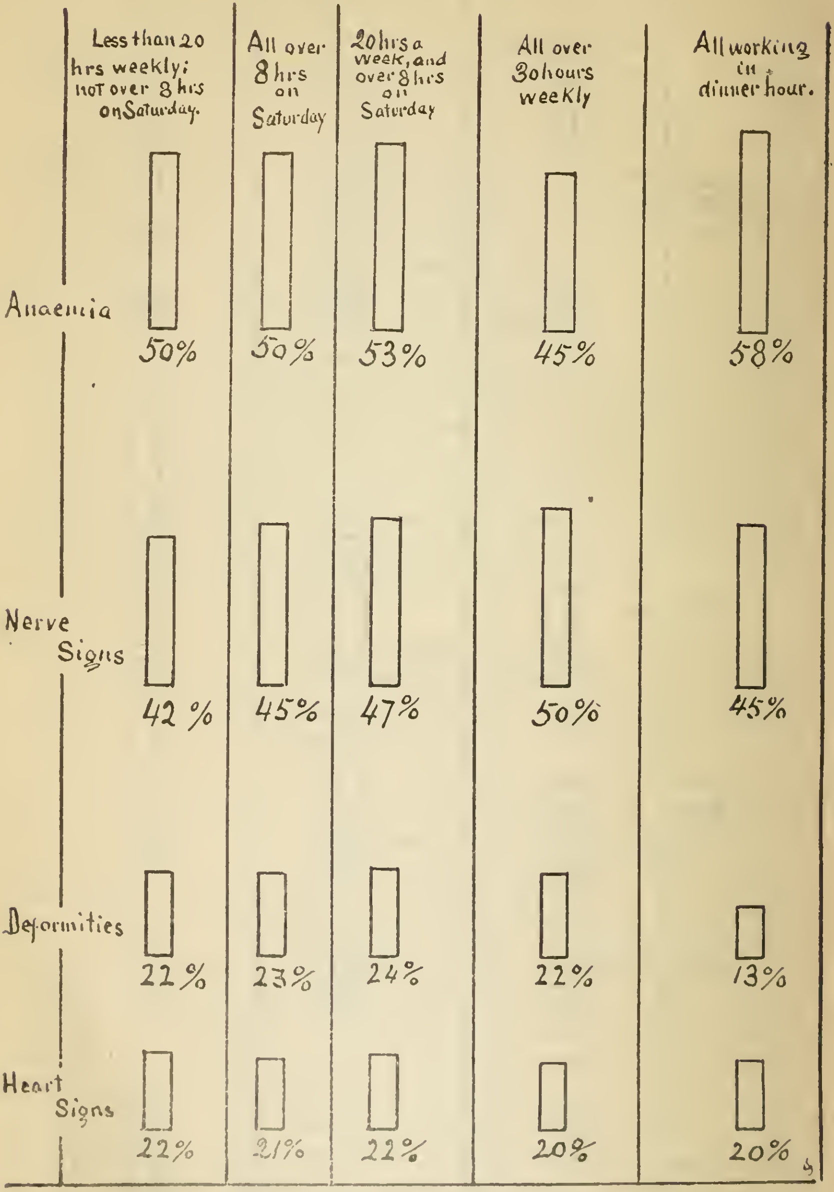
More startling was the evidence given as to the effects of carrying weights in the years below adolescence. The number of nonwage-earning children found to be suffering from deformity, incipient or developed, was 8 per cent. The percentage rose for bakers and carrier boys from 20 to 25 per cent, according to the number of hours of labor. The bakers' boys did not carry weights. They naturally carried the basket, however always on the right, or, in some cases, on the left arm. The result was a falling on that side so noticeable that the doctor on entering any school room can easily pick out all the bakers' boys. Anyone who understands what the ulterior effects of this deformity may be will regard it as serious.

The milk boys (who suffer from lack of sleep) stood very badly after a few weeks, showing a sudden rise of from 8 per cent to 20 per cent of deformity cases. Whereas only 24 per cent of the nonwage earners showed acute nerve symptoms, 28 to 50 per cent (according to the hours worked) of the wage earners had acute nerve symptoms.[2] The girl nurseses suffered from lateral curvature. The barbers' boys were the most unfortunate of all. Seventy per cent had serious signs of heart disease or anemia after a few weeks' work. This occupation is described as fatal for children. Setting aside for our purpose here the enormous amount of disease and defect caused by the employment of children we have to emphasize only the fact that monotony, even in the mode of using the large arm muscles and without any heavy physical strain, induces deformity. The inference is that the muscular and nervous system of a child of 14 years old is not adapted for specialized muscular labor or for muscular strain of any kind. The swift and dreadful effects of the barbers' shop work are to be attributed to various causes, of which foul air and strain (owing to long hours) are among the chief.

There is another aspect of the question which is very rarely touched on—to wit, the mental aspect—the effect of child labor, not only on the spinal and muscular system, but on the whole brain. A boy or girl in the years before adolescence has to learn the gymnastics not only of working, but of thinking. All the more obvious kinds of muscle activity, implied in what we call work, play, etc., lead on to that form of activity of whose processes we know nothing save that thought and will act on the muscles and by the muscles. That thought is quite literally a muscular thing, evidence of the most various kind is at hand to prove. To keep to the results of the experiment cited of 330 wage-earning boys Dr. Thomas found 86 who were one standard behind their age; 83 were two standards in the rear; 37 were three standards behind boys of their age, and 3 were four standards behind. It may be suggested that these children were of an inferior type, mentally and physically, but on the contrary a large percentage of them were above the average, not below it, before going to work. It would seem that only a very small number could be described as in any way below normal, while 17 per cent were found to be exceptionally bright. They were at the top of the school. Some had been marking time for a year. "These results show," said Dr. Thomas, "that child labor out of school hours is a wanton dissipation of


III Newsboys
Working 20 hrs
20-30 hrs
Over 30 hours
Fatigue
57%
60%
91%
Anaemia
19%
30%
73%
Nerve Signs
16%
35%
37%
Deformities
0
10%
10%
Heart Signs
0
5%
27%
McMillan

IV.


Less than 20 hrs weekly; not over 8 hrs on Saturday.
All over 8 hrs on Saturday
20 hrs a week, and over 8 hrs on Saturday
All over 30 hours weekly
All working in dinner hour.
Anaemia
50%
50%
53%
45%
58%
Nerve Signs
42 %
45%
47%
50%
45%
Deformities
22 %
23%
24%
22%
13%
Heart Signs
22%
21%
22%
20%
20%

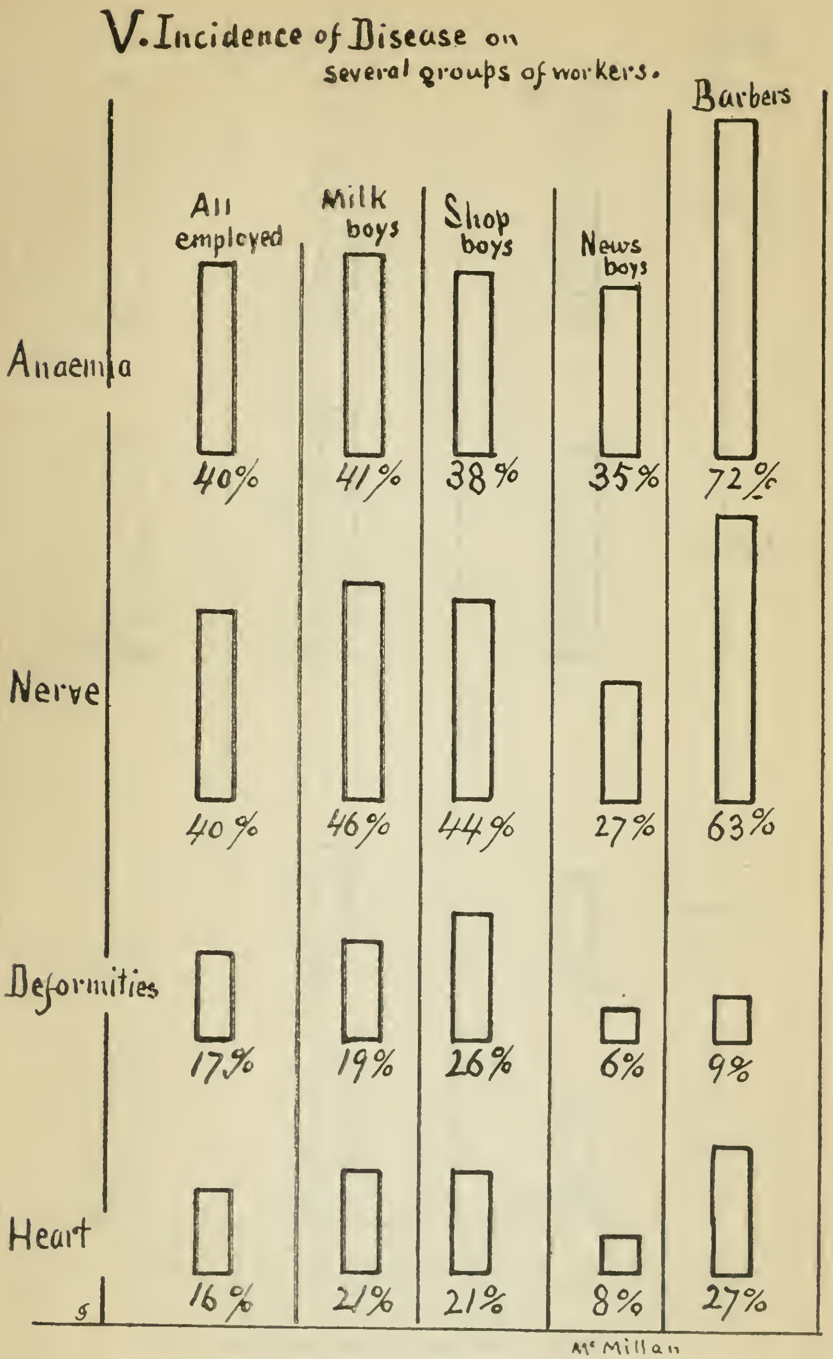
children's powers and that the evil effects of it fall on the best children." The amount of work determined the amount of deterioration in a striking way. Of the boys working 20 hours per week, 15 per cent showed serious heart symptoms. Of those working 30 hours per week, 20 per cent had severe heart signs. Acute nervous symptoms were present in 50 per cent of boys working 30 hours.[2]

Happily, America has not gone in for the half-time system. It was one of Britain's blunders. But even to-day America allows the children of some States to labor during longer hours than even the half-timer has to put in. It is worth while to cite here at least one order of evidence showing how these must suffer in mental development, and how we can no longer think of mind and muscles as things that have no association. Mosso measured the hand grips of laborers, of clerks, and of trained physiologists. The laborer, in spite of his great weight, registered a low figure on the dynamometer. The scientist's fingers, reenforced by the cumulative power of a trained nervous system, showed an energy greater than the clerk's, and vastly greater than that of the laborer. And here we are at the crux of the whole matter. Behind the lower level cortex, and screened by it, there are great silent areas of the brain whose processes are hidden, but whose activity, so far from being divorced from the muscular system, acts on the muscles and by the muscles. Physical education begins in crawling and in grasping things. It is carried on by all activities and training, by work and play, by reading and drawing, and getting control of the larger, first, and then the smaller, or fine, muscles. But beyond that there is a gymnastic of thought and will, of voluntary attention and inhibition, that leads on to higher conquests, and this has to be practiced in the years before adolescence.

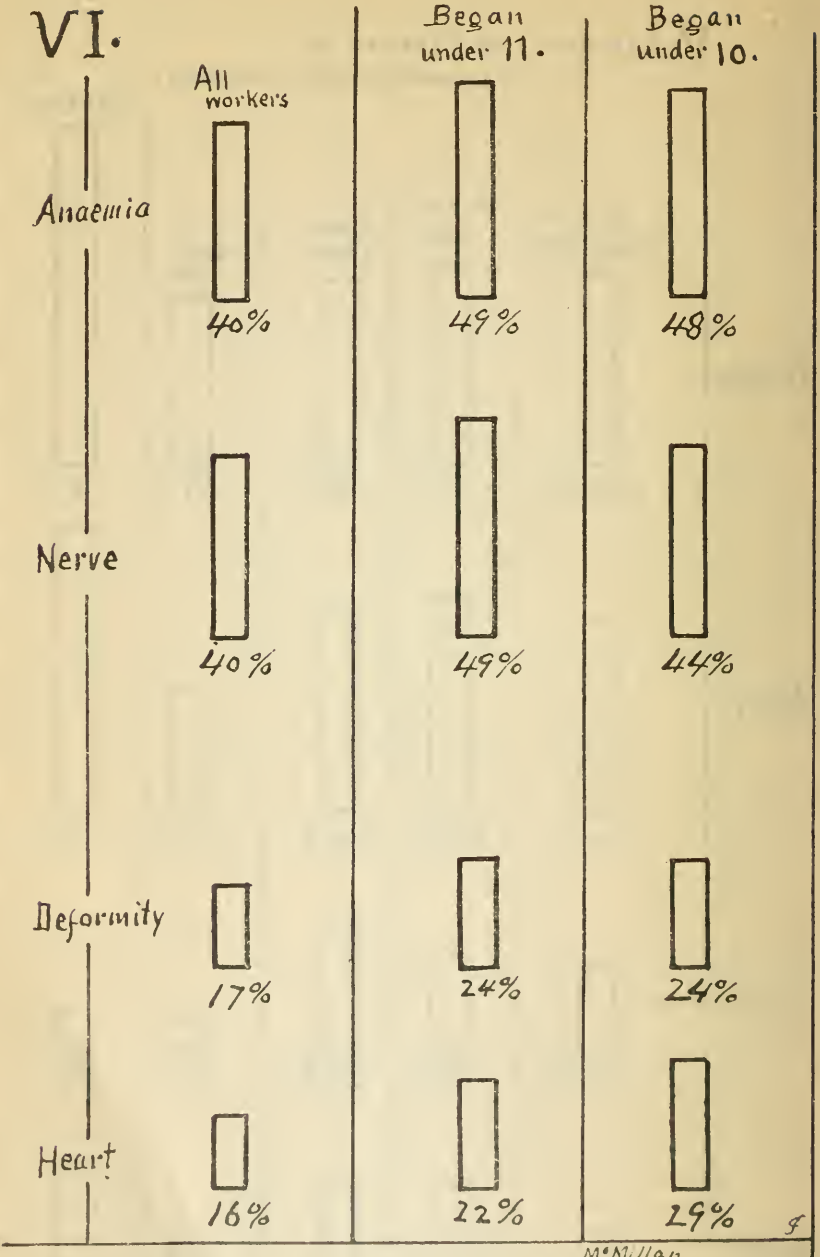
Again let me refer to observations made in the health centers at Deptford. After the operation for the removal of adenoids all the patients go to the teacher of remedial drill, so as to acquire new breathing habits, and to have the organs concerned in speech overhauled, as it were, and put in order. Most of the exercises are in a sense mechanical—as mechanical as the massage of stiffened lips, or the exercise of the long inert muscles of a typical " adenoid " face. But if one examines the various movements involved in the remedial drill one is struck by the fact that they are the movements of voluntary attention and interest. The diaphragmatic breathing, the closed glottis, the tightened lips, the slowly dilated nostrils, the steady eyes and front have to be acquired by practice and efforts. These movements are right ways, we say, of using organs. But they are more. They are integral parts (not mere accompaniments) of thinking itself. To acquire them is to acquire, in some degree, the power of thought itself. We may not only try to induce them; we hail their advent as the beginning of real mental awakening. Attention, however, is developed through them. Attention is an exceptional state, we know, because it is accompanied by the movements that imply stress and strain. That it is the birthright of every well-endowed human being to develop his attention-power we know, because we can not finally cure a disease, such as adenoids, without making the cured child once more a thinker. (The obstruction induces the state known as aprosexia, in which a child loses nearly all power of concentration.) As a matter of hygiene, then, higher education may be said to be necessary. The health is jeopardized when the mentality is arrested. The trained thinker lives long. The high mortality of the illiterate, and also the character of the diseases from which they die, shows that ignorance means literally death. (The death rate among unskilled town laborers is high. In the country many unskilled workers die of softening of the brain.) Life is a collection of functions that resist death, and the unlocking of the energy of every new nerve cell increases the power of resistance.

The effect of higher education can perhaps be best illustrated in the life of those to whom it is denied. In Yorkshire and Lancashire, where the half-time system is still in vogue, children may, even in the twentieth century, enter the mills at 12, and become full-timers at 13. It goes without saying that many of these children are bright and promising. They come from a race of hill-country people, who were once the tallest and finest men and women in Britain (though, alas, this fine physique has been lost in the factories). The children got through their "standards" fast, it is evident. Most of them, though not all, had to pass a certain standard, which is high for their age, on going to work. From the moment almost that they enter the mill certain well-defined changes take place in them. Their work as doffers, tenters, and weavers is restricted in character. They grow up into young manhood and womanhood and believe, perhaps, that they have suffered no loss. On quitting the mill in the evening many of them give expression to their relief in loud laughter and in horseplay. This, as a school doctor has remarked, is a symptom. The circulation of the blood, active all day in one prescribed area, now suddenly flushes neglected areas. The tension is removed. The mill girl shouts for the same reason that the writer or student gets up and walks about his study: only, in one case, we call a natural impulse "coarseness," and in the other, we give it no hard name.

Within the compass of Britain's small area, and by what one writer would call "the artistry of chance," another working-class community supplies an illustration of what happens when circumstances favor, not arrest, but development. The inhabitants of the Shetlands, the Orkneys, and the Hebrides, living isolated lives amid the wild northern seas, can not be regarded as originally of a higher


V. Incidence of Disease on several groups of workers.
All employed
Milk boys
Shop boys
News boys
Barbers
Anaemia
40%
41%
38%
35%
72%
Nerve
40%
46%
44%
27%
63%
Deformities
17%
19%
26%
6%
9%
Heart
16%
21%
21%
8%
27%
5
McMillan

VI.



Workers of various conditions in relation to age of commencing employment.

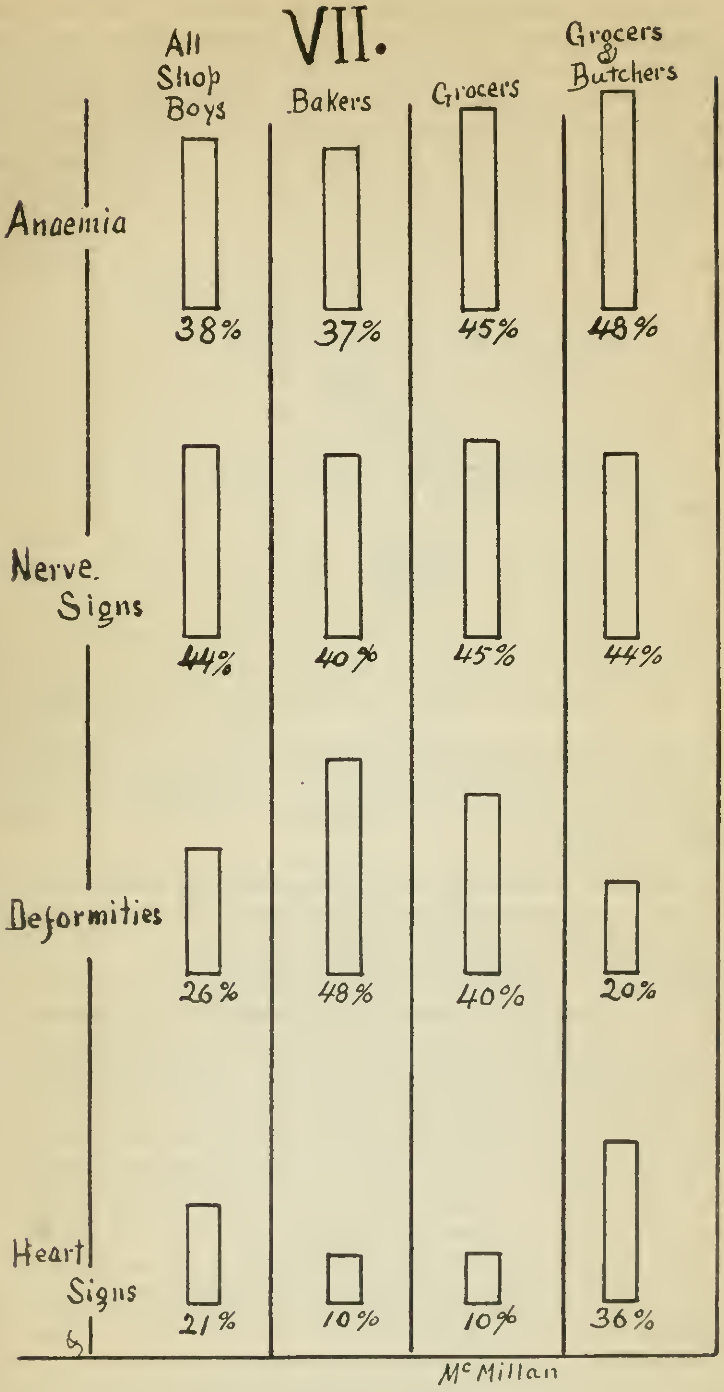
race than the mainlanders. Perhaps their ancestors were less enterprising, on the whole, than their fellow Britishers. In any case, here they remain like limpets, clinging to the rocks, half forgotten or seldom remembered and farther away, for practical purposes, from the motherland than are the dwellers in Tennessee or California. When Queen Victoria died, New Zealand had the news cabled. but many Hebrideans did not hear of it for nine days. Yet here, where modern industry has hardly yet planted her foot, and where people have never seen a tree or a railway train, you must look for Britain's richest crop of students in the higher fields of learning.

Some years ago the governors of the trust for education in the Highlands and islands of Scotland offered about 60 bursaries to be competed for annually by the children in public or State-aided schools. These boys and girls are examined in Greek, Latin, English, German, French, and science. If they were living in any of the great industrial centers, there is no doubt that the charge of overpressure would be brought against the examiners. Sir James Crichton Brown, to whom British children owe so much, has shown how overpressure does exist to-day and, above all, existed yesterday in our schools. The burden may have been light, but it was too heavy for the fatigued children of the capital. But the children of the isles are not weary. Their life is full of movement, of variety. They go out in the boats; they climb the rocks; they are active in the peat moss and on the shore; they help to build their own rude houses; they see the arrival and departure of birds all the year round; and in their homes they listen to the story of their ancestors, told in vivid, graphic words. That movement among memories which we call imagination is stimulated much and often. What is the result? "They got through the arithmetic book," said one Highland mother, "but its just a bairn's book. Too easy." "It's a pity that, at school, they can't go farther in Euclid," said another mother, "they're just playing." The results of examinations held in 1907 and the following years, and commented on, when published, by Mr. Dey, of Aberdeen, the chief examiner, are so remarkable as to challenge attention. The islands of the west and north of Scotland, sparsely inhabited as they are, yield, in proportion to their population, five times as many bursars and students of university standing as any district or area of the mainland. That is to say, that the capitals can not compete with the isles. Like a flight of strong birds, flashing above a struggling modern greyhound steamer, these win home to the goal. And where does this power of sustained attention come from, and this interest in the higher aspects of life and mentality? It is reasonable to believe that its comes from within; that it is part of the garnered treasure of the race; that the islanders have realized it; that the mainlanders are in danger of losing it (for some reason or another); that they, too, might realize it, for it is theirs. But modern industrial methods, so costly, are depriving them, somehow, of their best heritage.

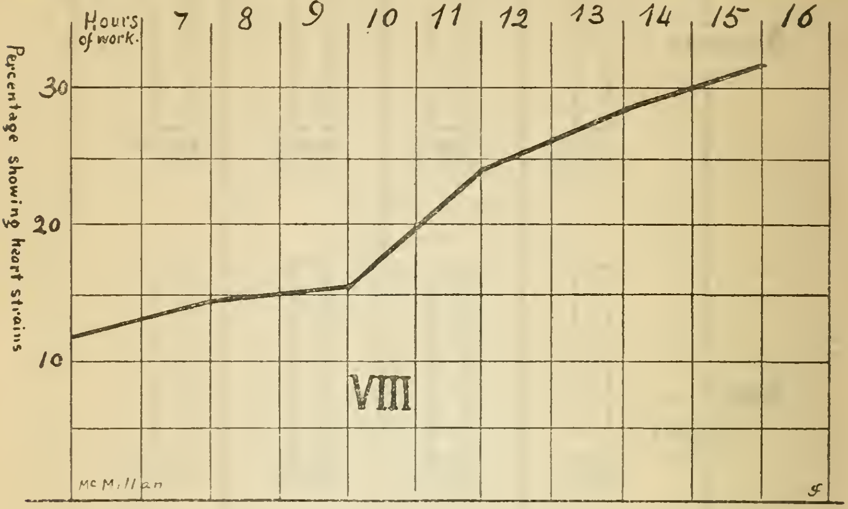
For the factory child, the newspaper and milk boy, the wage-earning children who leave our schools in tens of thousands every year, do not long to enter the universities. They can not be induced to go to even a recreative evening class, save in the proportion of one out of three. The effect of monotonous toil before adolescence is not to be looked for in our medical statistics alone. It is to be traced in the habits and desires and amusements and tastes of a people. The trend of those who have to labor early in mills, workshops, or in other centers of industry appears to be toward the winning of passive forms of sensory stimuli. The disinclination for any but the simplest forms of muscular or voluntary exertion surely indicates a certain torpor of the higher brain centers, whose activity is the crown of a nation's, as of an individual's strivings.

What is the position of an adolescent and of a boy or girl on the verge of this period to-day? In some respects the century in which he is born is an unfortunate one. Industry is becoming more and more differentiated, and with this differentiation comes the need of vast armies of lowly specialists, of workers who have not simply to learn what drudgery means, but who can hardly learn anything more. This is as true in the laboratory as in the factory. The laborers who obey orders and execute monotonous tasks are not following, but only serving.[3] Meantime the brighter children of the working class are ready to leave school before adolescence and what is even more grievous, they are marking time in many instances during the last year of primary-school life. For various reasons the home can not offer either the sensory experience or the higher order of training in the years before and during adolescence that would arm the young man or woman to meet such conditions as await him. The task of the school is, of course, a more or less restricted one. But, owing to the nature of modern industrial conditions, it is gaining a new significance and growing importance. The school is becoming more and more a way of escape, a door of hope, the only one for many. Its success would appear to depend on the ability to offer, in the first place, a certain amount of nurture (as distinct from mere treatment of a detail character, such as the care of teeth, eyes, ears, etc., though including all these) and, secondly, on its power to offer a fine and continuous training or drill that will insure the awakening and development of the higher brain centers and carry the young citizens beyond the risk of deterioration through monotonous toil in adult life. But above all it depends on the provision of or stimulating environment for the young—a restoration to open-air life by night and by day.

Our notions on the scope and possibilities of physical culture may be indefinitely enlarged. Ling has not spoken the last word on it.


VII.
All Shop Boys
Bakers
Grocers
Grocers & Butchers
Anaemia
38%
37%
45%
48%
Nerve Signs
44%
40%
45%
44%
Deformities
26%
48%
40%
20%
Heart Signs
21%
10%
10%
36%
Mc Millan

In Paris, Roguet, the pupil of Binet, is showing how feeble wits may be strengthened; how the lethargy of the perceptive powers, the imagination the memory, can be broken up by a form of drill that admits of indefinite variety and expansion. Mental gymnasia are the corollary of (so-called) physical gymnasia. Once the health center and mental gymnasium are incorporated in the public-school system, and the age raised to 16, the young generation may be practically shielded against the deteriorating effects of industrial life. To equip these and to develop them may, we hope, be a part of the mission and triumphs of America.



Increase of heart strain with increase of labor. Rapid increase when work exceeds 9 hours.

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[1] As this dullness appears to be a very serious matter, inasmuch as te higher brain centers are certainly dependent on the richness of a lowlier life and are fed by it as the rivers are fed by the rains and the springs, it may be permissible to say a word or two as to the means taken to remove it.

The night camp is in the midne of the slum region, but the air is nevertheless wonderfully pure, especially at night. It is furnished with hot and cold baths. The garden is full of plants. The sleeping shed is open entirely on one side and partly open on two of the other three. Baths, massage, exposure to open air and sunlight, and the training of the attention in all that concerns the basal senses are ncluded in the educational method. The means are also an occasion for training in taste. The mothers come to see their children go to bed. In this way they share directly in the educational work, and the neigbors, looking out of their windows, begin to understand very soon the new ways of livng.

[2] Of all school children, working and nonworking, 25 per cent have anemia, 8 per cent are deformed, 8 per cent show severe heart signs, 24 per cent show severe nerve signs. Of the wage-earning (20 to 30 hours per week), 47 per cent are anemic, 44 per cent had severe nerve signs, 21 per cent are deformed, 15 to 20 per cent show severe heart signs. The children working over 30 hours a wek are in a worse condition.

[3] The writer was informed by Prof. Turner, professor of astronomy at Oxford, that even in the laboratory of the scientist the young men engaged have to be content to do drudgery with little hope of joining the few who do research work.

CHILD LABOR IN THE UNITED STATES.

Owen R. Lovejoy, General Secretary National Child Labor Committee.

The present address must be a plea for the development of scientific study of the physical effects of child labor in America, rather than an exposé of the results of such research. For, as a matter of fact, no such study has been made, and we are still in the position of those who fight an enemy of the human race without waiting to learn by experience the extent of its virulence. This is said not as an apology, but by way of explanation.

When the National Child Labor Committee was organized eight years ago, there were no accepted standards of protection against child exploitation. Boys of 10 years were common in the blinding dust of coal breakers, picking slate with torn and bleeding fingers, or sweltering all night in the glare of the white-hot furnace of the glasshouse; the incarceration of little 10-year-old girls in the dust-laden cotton mills of the South; or the silk mills of Pennsylvania for 12 hours a day was looked upon with approval or indifference; tobacco and cigarette factories, canneries, sweatshops, the street trades, and the night messenger service all took unchallenged toll from schoolhouse, playground, or cradle, and, despite the evidence gathered from England, Germany, and other European countries attesting the waste and folly of the system, child labor was almost without an enemy in America.

The initial duty in the premises we conceived to be to organize a campaign of opposition to such forms of the abuse as ought to be obvious to any person of intelligence. We believed, for instance, that no scientific data are required to prove that the employment of a 10-year-old girl for 12 hours a night in a Southern cotton mill or a 10-year-old boy for 9 hours a day in a Pennsylvania coal breaker is injurious to the health of the child. It seemed wholly gratuitous to suggest that detailed comparisons should be made of the physical development of such children with those not thus employed in order to prove that such labor of children should be forbidden.

We undertook to direct such activities as would immediately combat the more inhuman forms of the system and attempted at the same time to awaken and stimulate an attitude of scientific statesmanship among those qualified by medical and hygienic training to discern facts not patent to the layman.

A brief summary of the results of this somewhat militant campaign brings out the fact that during the past eight years the age limit for employment of children has been standardized, and no state can look upon itself as enlightened which permits employment of normal children under 14 years of age in manufacturing or mercantile establishments. In occupations known to be hazardous or dangerous to health the minimum has been fixed at 16 or 18 years; working hours have been reduced in 10 states to 8 per day and 48 per week; night work for children under 16 has been forbidden, and other safeguards have been thrown around minors who are allowed to continue in employment.

The chronological age test for children seeking employment, which was general eight years ago, has been supplemented in many states by requiring sufficient physical examination to at least discover whether the child corresponds to the norm for its age, and the public now generally recognizes that educational and physical tests are essential to any adequate dealing with the problem of committing children to industry. Suggested methods of testing the physiological age of the child have been contributed by various specialists, among whom in this country perhaps the most prominent are Dr. Thomas Morgan Rotch, of the Harvard Medical College, and Dr. C. Ward Crampton, of the New York public school system. The one suggests the Roentgen ray to test the bones of the wrist and the other advocates reliance on certain more superficial evidences of puberty. Unfortunately the profession is thus far so widely at variance on either the feasibility or the accuracy of such tests that they can serve no practical purpose for the untrained layman. Meantime we have relied upon the general principle of advocating the maximum standard of protection, and combining the age record with such physical tests as can be made in school or health offices.

In an address before the fourth annual meeting of the National Child Labor Committee, Prof. Charles R. Henderson, of the University of Chicago, said:

> We already have ample medical information for a fair judgment of the effects of premature factory labor, and the experience of older countries has value for us.
>
> It is certain that exhaustion by fatigue is to be charged with a very great number of occupational accidents. Children and youth placed in positions which require maturity of muscles, nerves, and judgment are necessarily heedless and awkward. They endanger themselves and others, especially when they are weary. The records of accidents by age and by hour of the day are significant in this connection.
>
> Premature child labor in mine, mill, and factory increases exposure to some occupational diseases. Certain poisons, dust, vapors, and germs may be resisted or tolerated by vigorous men which are fatal to young persons and women.

And at our seventh annual conference, Dr. Henry Baird Favill, of Chicago, said:

> As a practical proposition, nobody can question that the effect of long hours, rigid duties, sustained effort, and more or less bad hygienic conditions which prevail of necessity in industrial pursuits, are damaging to the physical welfare of the individual child. If damaging to the physical welfare, there is equally no question that it is limiting to the mental development and perversive of the moral development to a greater or less extent. Let us grant, for the sake of extreme fairness, that teaching a child dexterity, industry, and responsibility

has a value. Can any honest mind doubt that these alleged advantages are more than offset by teaching it the dexterity of an automaton, the industry of a driven slave, and the responsibility of a premature burden bearer?

But as lines are more closely drawn, the need for scientific research and an accumulation of expert evidence become more apparent. There are sections of the country where it is still possible to employ children of 10 or 12 years for excessive hours and under conditions considered unsanitary even for adults. And these conditions continue without the violation of law and with the approval of public opinion. The valid principle that employment is better for children than idleness is frequently made the basis for systems of child-wage slavery which disgrace our civilization.

In every legislative campaign we enter, the claim is advanced by those who oppose reform, that conditions are not injurious. Cotton manufacturers defend the employment of little children by picturing the cotton mill as a health resort, and drawing lurid pictures of the disease-laden farms from which the industry has rescued the helpless child. Glass manufacturers contend that boys are better off at work all night than during the day, because it is cooler at night and because the boys themselves like it better. The great fruit and vegetable canning industry pictures its rush season as an annual picnic for the thousands of mothers and children who luxuriate in a labor week of 75 to 90 hours in sweltering or storm-swept cannery sheds. The exploitation of little children by commercialized industry within their own tenement rooms has been almost wholly unchecked, because of the popular tradition that the parents own the children, and that "a man's home is his castle."

Evidently, more conclusive facts are needed by wise scientific research to complete the emancipation of working children. And we welcome the opportunity afforded by this great congress of scientists to submit the following concrete suggestions in cooperation, all of which have been urged at conferences of the National Child Labor Committee, but none of which have been put into full practice:

I. We first urge compulsory registration of births in all states, and the requirement of a birth certificate when a child wishes to work in a factory. This requirement is of importance from many points of view. We shall never establish sound principles of public health in this country, nor lay the basis for accurate statistical tabulation, until we at least know the date of birth of the subjects to be tabulated. The demands of education, citizenship, property inheritance, and other considerations join with the requirements of public health in demanding this service of our commonwealths. In nearly half the country birth registration is the exception, while within the registration area ignorance or nonobservance of the law is so frequent as to vitiate many deductions drawn from attempted age tabulations. An accurate registration system would stop the perjury of many parents and many of the evils of child labor under legal age. When, some three years ago, a law was passed in Pennsylvania, requiring documentary proof of age before work certificates could be issued, it was estimated by citizens of that State that not less than 12,000 or 15,000 children were taken from the mines, mills, and mercantile establishments and returned to school.

II. Let the health experts in each state demand of their state government a complete record of industrial accidents and diseases, recording the age of each person injured, so that we may know authoritatively what relation child labor bears to hazardous industries.

Information has been gathered from various states to supplement expert evidence upon which we have based a legislative program to exclude children under 16 years from any of the following occupations:

> (1) Adjusting any belt to any machinery; (2) sewing or lacing machine belts in any workshop or factory; (3) oiling, wiping, or cleaning machinery or assisting therein; (4) operating or assisting in operating any of the following machines: (*a*) Circular or band saws, (*b*) wood shapers, (*c*) wood jointers, (*d*) planers, (*e*) sandpaper or wood-polishing machinery, (*f*) wood-turning or boring machinery, (*g*) picker machines or machines used in picking wool, cotton, hair, or any other material, (*h*) carding machines, (*i*) paper-lace machines, (*j*) leather-burnishing machines, (*k*) job or cylinder printing presses operated by power other than foot power, (*l*) boring or drill presses, (*m*) stamping machines used in sheet metal and tinware or in paper and leather manufacturing, or in washer and nut factories, (*n*) metal or papercutting machines, (*o*) corner-staving machines in paper-box factories, (*p*) corrugating rolls, such as are used in corrugated paper, roofing, or washboard factories, (*q*) steam boilers, (*r*) dough brakes or cracker machinery of any description, (*s*) wire or iron straightening or drawing machinery, (*t*) rolling-mill machinery, (*u*) power punches or shears, (*v*) washing, grinding, or mixing machinery, (*w*) calendar rolls in paper and rubber manufacturing, (*x*) laundering machinery; (5) or in proximity to any hazardous or unguarded belts, machinery, or gearing; (6) or upon any railroad, whether steam, electric, or hydraulic; (7) or upon any vessel or boat engaged in navigation or commerce within the jurisdiction of this state.

This bill also provides that—

> No child under the age of 16 years shall be employed, permitted, or suffered to work in any capacity (1) in, about, or in connection with any processes in which dangerous or poisonous acids are used; (2) nor in the manufacture or packing of paints, colors, white or red lead; (3) nor in soldering; (4) nor in occupations causing dust in injurious quantities; (5) nor in the manufacture or use of dangerous or poisonous dyes; (6) nor in the manufacture or preparation of compositions with dangerous or poisonous gases; (7) nor in the manufacture or use of compositions of lye in which the quantity thereof is injurious to health; (8) nor on scaffolding; (9) nor in heavy work in the building trades; (10) nor in any tunnel or excavation; (11) nor in, about, or in connection with any mine, coal breaker, coke oven, or quarry; (12) nor in assorting, manufacturing, or packing tobacco; (13) nor in operating any automobile, motor car, or truck; (14) nor in a bowling alley; (15) nor in a pool or billiard room; (16) nor in any other occupation dangerous to the life and limb or injurious to the

> health or morals of such child; (17) nor shall any child under the age of 16 years be employed upon the stage of any theater or concert hall, or in connection with any theatrical performance or other exhibition or show.

This standard of restriction was indorsed in 1911 by the National Conference of Commissioners on Uniform State Laws, and in August of the present year by the American Bar Association in general session. These suggestions have been adopted, with slight modifications in Arizona, Colorado, Connecticut, Illinois, Maryland, Minnesota, New York, Wisconsin, and a few other states. Massachusetts further provides that the State Board of Health may from time to time determine whether any particular trade, process of manufacture, or occupation, or any method of carrying it on is sufficiently dangerous to the lives, limbs, health, or morals of children under 16 to justify their exclusion therefrom, and this provision has been recently applied substantially in Arizona, Kentucky, and Oklahoma.

III. But many occupations in which children engage can not fairly be classed with what Dr. Thomas Oliver calls "the dangerous trades." They are occupations in which adults may engage for many years without apparent injury to health, and in many, the number of accidents or cases of acute illness of working children is small. None the less, the principle of health preservation requires that the more subtle evidences of all industrial injuries shall be carefully studied and recorded.

At the fifth annual conference of the National Child Labor Committee Dr. Albert H. Freiberg, of Cincinnati, in an address on "Some Effects of Improper Posture in Factory Labor," said:

> During the period between 12 and 18 years we have to deal with physical and mental changes in the individual which are of enormous importance and which are recognized by everyone to be so physiologically—a period which is fraught with great dangers to the child, dangers mental, moral, and physical; a period during which the child grows more rapidly in length than at any other time save that of early infancy. * * *
>
> There is a vast difference between the work which a child's muscles do in factory employment and the work which that child will do if he is allowed to go freely as he chooses. A child between the ages of 12 and 16 or 18 years will, if given the opportunity, play and play hard. He will play baseball, play football, and he will use his muscles most energetically. * * * Therefore we are told by many who employ children, or who would like to employ children at this age, that they are not using their muscles to any greater extent than they would use them if they were given simply that to do which they would choose to do, meaning thereby play.
>
> Muscular exercise is beneficial. Exercise is our only means of strengthening the muscles, of encouraging their development, but the building up of a muscle which is actively growing and developing must be accomplished by exercises which are not too severe, which are not too long continued, and which are of constantly varying character.
>
> Furthermore, the muscle which carries out exercises must be given frequent periods of rest, during which it may recover. It should be given an opportunity to build up again that which has been consumed by use.

What happens when a child is employed in a factory? The child is employed in a factory as a rule in one of two ways—either in a standing or in a sitting occupation. Sometimes the character of the occupation is such as to combine the evil effects of both these positions.

As in the case of the child at the loom. That which is unfortunate in factory employment as far as purely physical effects upon the muscles are concerned is the fact that a muscle must perform its functions for a long period of time without the opportunity of relaxing, without the opportunity of recovering. When a muscle has performed its function up to a certain point we experience the sensation which we speak of commonly as "fatigue." Fatigue means that there is an accumulation in the muscle of the waste products of its use which have not yet been carried away and replaced by new material. If we continue to use a muscle far beyond the point of fatigue repeatedly, there results in that muscle in the course of time, instead of further upbuilding, a degeneration, and the result of such excess fatigue is the final weakening of a muscle which, if treated properly, would, on the contrary, grow stronger continuously. The result is that we find the children who are thus unable to change their position to relieve their overtired muscles taking peculiar positions, which at first we call "bad habits." We speak of the child that has round shoulders, for example, as habitually holding himself badly. Why does he hold himself badly? Simply because his muscles are not capable of holding him in a proper position. * * *

So with the child sitting at the machine, so with the child standing at the workbench continuously for periods varying from six to eight or nine hours a day. It is the lack of opportunity to relax, the lack of opportunity for these muscles to gain within a reasonable length of time what has been used up, which causes degeneration to take place, which causes this weakened condition to take place, and by reason of this weakened condition certain postures which are abnormal and which will develop into deformity.

At a former conference of the Naional Child Labor Committee[1] I stroke to show how premature employment in standing positions tends to produce postural deformities of the feet; how sitting employment in young children tends to cause distortions of the spine and chest and to what extent the conditions thus produced are likely to interfere with future industrial efficiency, as well as future health and chances for a normal tenure of life.

Standing occupations naturally involve the feet and legs in greatest strain, and more especially the feet. In consequence we see developing during the adolescent years that condition known as weak and flat foot. * * * Later, when the child has become the father and the necessity for continuous employment is apparent, the feet only too frequently become so painful that long abstention from work is imperative, and it happens not rarely that an entire change of employment can not be avoided. Thus are lost the skill and aptitude acquired during the period of prematurity. * * * Turning now to the girl in the sitting occupation, I would attract your attention to the frequent occurrence of curvature of the spine, spoken of as "lateral curvature."

Do health experts generally agree with the position so forcefully taken by Dr. Freiberg? In any event the general public has never caught the principle, and up to the present date no serious attempt has been made in any part of this country to study the effects of premature toil in industries which demand constant standing or constant sitting. Laws have been passed in several states requiring that seats shall be provided for girls and women, and some states prohibit employment of females in occupations which compel them to stand constantly. But if the birth of a child by a mother whose body has been wrecked by constant standing is a misfortune to society, is it not almost an equal misfortune for a child well born to be compelled during the period when its education and health should be most vigorously promoted to look for support to a flat-footed father, who in middle life is relegated to the industrial scrap heap?

If the position of Dr. Freiberg is sound, it is the obvious duty of every state board of health to make a careful analysis of the conditions required by every industry, measure the degree of liability to the health of employees, and lay before the public such evidence as shall lead to the exclusion from every industry which requires improper posture of every child who has not yet reached sufficient physical maturity to withstand the strain.

We urge at this point the propriety of study outlines prepared by state medical associations or by the medical departments of state universities, so that students, practicing physicians, and health officers may learn to accurately record and tabulate the physical demands upon employees in every industry. Any industry that declines to cooperate in such a study will become outlawed by this new spirit of health conservation.

IV. Our fourth suggestion calls for the development of complete hospital records to the extent of covering all industrial facts. When a child is brought to the hospital or clinic suffering from defective sight, defective hearing, malnutrition, spinal curvature, broken arch, venereal disease, or accident, the customary record throws no light whatever upon the causes leading to the child's condition. If a 16-year-old girl treated at the hospital for lateral curvature is discovered to have been employed in a given industry, and in an almost unchanging position, from her tenth or eleventh birthday, is it not conceivable that the two facts have some relation? If an 18-year-old boy with venereal disease is found to have been employed as a night messenger catering to prostitutes and degenerates from the time he left school as a truant at 10 years, may there not be something more than coincidence?

In other words, just as society has already undertaken to regulate the ventilation of work places and to restrict employment where dangerous explosives and poisonous gases are used, so society must recognize the direct relation to the worker of posture and strain, dust, heat, cold, compressed air, glare, darkness, speed, and noise. And the child not inured to the rigors of life must be safeguarded against these phenomena of industry according to the degree of hazard involved.

V. Our fifth suggestion is for the further development of our public health departments, with especial reference to the examination of children in industrial occupations. This public service has been to some extent developed in Massachusetts, and creditable work has been done by the State Board of Health. In other states but slight beginnings can be recorded. Even in Massachusetts the public seriously handicaps its agents in their study of the health of young persons in relation to occupations by requiring more work than can be done with the limited appropriation for carrying out the statute provisions. Among the subjects of investigation required of the State board of health are:

1. The prevalence of diseases dangerous to public health in home, schoolhouse, factory, or elsewhere.
2. Sanitation of schoolhouses and industrial establishments.
3. Information concerning the health of young persons in factories at their work, and the influence of such occupation upon the health of these minors.

The chief defect in the Massachusetts system is the lack of proper places for physical examination of young persons whenever, in the opinion of the State Inspectors, such examination is advisable. As pointed out by Dr. William C. Hanson, of the State Board of Health:

> This is the most serious handicap in connection with the work of the inspectors, not only because the absence of suitable places for examination of minors means inaccurate and incomplete data concerning their health, but because the absence of accurate and complete data means the impossibility of accurate statistical information to show either the percentage of minors in ill health in our factories or the percentage of minors whose health is more or less affected as the probable result of injurious influences of different occupations or processes.

Dr Hanson says:

> When conditions of ill health or of physical unfitness are discovered, aside from communicable diseases, two courses are open to the health inspectors: They may inform the child's parents, or, if to the child's advantage, his employer. Many have been aided, if not completely relieved, by the willingness of an employer at the suggestion of the health inspector to change their work, and, in some instances, by the interest of employers in paying in part for treatment of children found in their employ afflicted with a disease like tuberculosis. On the other hand, in the absence of authority to exclude from factories young persons found in ill health or physically unfit, the parents of the children take but little notice of information and advice given them.[2]

Physical examination of school children has become common in many states, and, at the eighth annual meeting of the National Child Labor Committee, Dr. George F. Ross, Superintendent of Health, Guilford County, N. C., urged the importance of extending medical inspection from schools to mills. In defending the necessity for such examination, Dr. Ross contrasted the factory conditions with those of rural communities, and said:

> Boys in the country may spend the same number of hours at work as the factory boy, but usually a country boy's work is outside, while the mill boy works in a steam-heated building, where air is hot and moist or dust laden—a condition conducive to enlarged tonsils and adenoids, which predisposes to lung trouble and lowers his powers of resistance for other infections.
>
> Another reason for medical examination of mill children is because of night work. * * * With the long hours at a time when children, of all people, should be asleep, with their lunch at midnight, improperly prepared and hurriedly eaten, and with their broken rest the day following, these boys and girls can not get their normal development.

But the menace to health which makes this demand upon our public service is not only for the protection of the child itself, but for the protection of the community. Quoting again from Dr. Hanson, of the Massachusetts State Board of Health, at the sixth annual conference of the National Child Labor Committee:

> In the school, when such affections as pediculosis, scabies, blepharitis, trachoma, etc., are detected they are vigorously excluded until remedied. Why not in the factory? In the school each child's sight and hearing are tested annually. Why are not the sight and hearing of each young person in a factory tested annually and a judgment formed for each child based on the kind of work done and the conditions under which the work is done? Why should not children in factories receive even greater attention than those in our schools, when many factory children are exposed to influences far more inimical to health than the conditions to which school children are subjected in schoolrooms and for longer daily periods?

VI. We have frequently referred in this paper to the physical examination of school children, and their remains, as our final suggestion, a brief reference to this matter.

In the development of health standards for regulating the employment of children, we believe the public-school system should be called into requisition. The school furnishes the ready channel through which the American child may pass and be checked, classified, and tabulated with the least expenditure of time or money.

The commission to codify and revise the laws of Ohio relating to children recommends compulsory medical inspection of school children throughout the State in both urban and rural communities. This is a significant step to take, as the custom in most states which recognize the need for physical examination is to confine it to those school children who show marked abnormality, or, more commonly, to confine it to children arrested under the juvenile-court law.

At present, in a number of states, the law requires that when a child leaves school and seeks employment the school physician or local board of health shall certify to the child's physical fitness for its position. This is the highest standard thus far reached for recognizing the physical aspect of this problem. That it is superficial and inaccurate is obvious. We have for several years urged that the states which have gone thus far ought to take the next step, and develop a real system of physical examination. It would be possible to examine every child who enters the public school, make full note of the child's physical condition and physical history up to that period, and the card describing these conditions should follow the child with the persistency of its own shadow from room to room and from grade to grade, having entries made at least annually, and special entries recording absences for illness, cases of medical or surgical treatment, development of any physical defects, records of growth by height, weight, and other tests, so that at the end of the school career the authorities would have a six or eight year record of the child's physical history. Based upon this, working certificates might reasonably be issued, when the proper time comes for the child to work. Meanwhile the records would themselves throw significant light upon many problems which to-day are confusing and are dividing our leading educators.

Manifestly this invasion of the domain of industry by the conservators of public health and education presages the rapid development of public machinery to perform so important a function. Closer relations must be maintained between our health and education authorities, in order that the metal record of the child and his physical record may not be regarded as two distinct matters, but as different phases of the same problem. The discovery that 100 children in a given school have defective vision presents a problem in education and a problem in health, but both problems relate to the same 100 children. At a conference of public-school officials we should have something to say about the better equipment of our schools, and a more comprehensive grasp of their duty to all the people, but at this Conference we need say only that in many states the public has not thus far given sufficient attention to the conservation of health to even provide agencies for that purpose. In many states, the state boards of health are without equipment or adequate financial appropriation, while many local health authorities are without either equipment or intelligence to perform their work.

The public must put an end to incompetence or self-interest in its public-health service, and we submit that medical associations, state boards of health, physicians, and experts in hygiene—those who best know the facts—must serve as pioneers in demanding that the public-health department shall be elevated to its rightful place, and be made the most important arm of city, county, or state government.

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[1] Third annual conference, 1906. See National Child Labor Committee's pamphlet No. 43, pp. 4 and 5.

[2] See National Child Labor Committee's pamphlet No. 131, p. 3.

THE CAUSES, EVILS, AND REMEDY FOR TENEMENT-HOUSE MANUFACTURING.

Dr. ANNIE S. DANIELS, New York City.

THE CAUSES.

For the manufacturer: A problem of economy is solved; he limits his plant to such space as may be necessary to prepare the work, thereby saving the cost of maintaining a factory only, and the great obligation of obeying all the laws relating to factories and their workers. In the State of New York he is required only to keep a register of the name and address of the person to whom the work is given, to ascertain if the tenement is licensed, and to furnish a copy of this register to the State labor department. Here his responsibility ends.

For the workers: An inducement is offered to perform the work in their living rooms at all hours, day and night, Sundays and holidays, and the opportunity given to employ every available hand of 3 years old and over; to employ the aged and the sick; to give the materials to other families at other addresses, thus becoming themselves employers. Not infrequently, instead of giving out the work, they invite other workers to their rooms; they induce children to become apprentices, and, in their living rooms, create a miniature factory, more strictly a sweatshop, and subject to no law.

The articles manufactured include custom and ready made clothing for men, women, and children's wear. Literally every article of personal wear from the hat to the shoes; all kinds and grades of embroidery, including (as I have seen) church vestments and altar cloths; passementerie, buttons, flowers, feathers, hair switches, cigars, boxes of all descriptions, furs, and fur trimmings—articles allowed by the labor bureau, and some they never thought of; anything that can be carried by the worker. My knowledge of conditions in New York City is founded upon a study of those families who apply, at the New York Infirmary for Women and Children, for the free services, at their homes, of a physician, making my point of view a study of the poorest and most helpless class of tenement workers—ignorant of the language and conditions; a peasant class, still in the candle-light stage of civilization, suddenly thrust into the life of the electric light, the large majority of these families being Sicilians. No family has been included as doing tenement-house work, and no children except those whom I have actually seen at work and attended in my capacity of medical adviser.

THE EVILS.

To the manufacturer: None.

To the workers: The evils begin when they receive the goods at the loft, and continue until the article is returned as finished. From the loft, on the heads, the backs, and in the arms of men, women, and children, the heavy bundles are transported through the streets, up the tenement stairs, and later the finished product is borne back to the manufacturer. It matters not that the bundle weighs more than the child who carries it—that the woman's physical condition is such that the weight is a positive injury to her—the bundles must be carried.

During the 11 months ending September 1, 1912, I was called to attend 357 families whom I had not previously seen. Of this number, 176 families were at work on some kind of tenement-house manufacturing. In 3 of these families men at work were assisted by their wives and children; in 173 families, the workers were women and children.

Sanitary condition of the tenements of these workers.—Forty-six tenements were in moderately good sanitary condition; 124 were old, unimproved, dirty tenements; 6 were in a bad sanitary condition.

Referring to the bulletin of the labor department, which I receive monthly, 141 of these tenements were licensed; 35 were not. Of these rooms, 90 were small, overcrowded, dirty; 84 small, crowded, clean; 2 not fit to live in.

A note was made of the physical condition of these families. The general condition of one family was good; 8 were overcrowded; 162 were underfed in addition to being overcrowded.

Contagious diseases.—I was called upon to treat 79 of the 176 families for a contagious or communicable disease. Sixteen of these were scarlet fever; 9 tuberculosis; the majority were cases of measles; 1 the dreaded infantile paralysis. The usual notice of the board of health, calling attention to the disease within, was on the door, the work continuing just the same. I find that under these circumstances the work is obtained from a neighbor, at another address, and that another name is given.

The hours.—These are absolutely unregulated; usually from 5 a. m. to midnight; workers average 16 hours of actual work every day in the week, including Sundays. The Italian seems to require less sleep than the others; neither the hours nor the days of the women are shortened by her physical condition. The pregnant woman works to the hour (sometimes literally) of her delivery. I have seen a woman up and at work 10 hours after her delivery. All resume labor not later than the third day. To my inquiry why they have no breast milk for their babies, they say: "How can I have milk? I must work." The city must supply milk stations. Death scarcely interrupts the work.

Child labor.—Some part of all the industries found in the tenements can be taught to a child of 3 years; I have seen younger toilers, but at 3 years a child's work can be counted. The girl of from 5 to 8 years is a decided addition to the working force; between her eighth year and the age at which she can be admitted to a factory she can do the work as well as her mother, especially in "finishing." The boy usually ceases to be useful as a houseworker after he is 8 years old; he can earn more money at a street trade.

The children's hours.—These vary from 5 to 12 hours in the 24. One child of 3 years worked at buttons and was called at 5 a. m., the mother pathetically stating that he did not wake easily. This child averaged six hours, during which his work was to cover a button mold with cord, his mother finishing it. In August the child died. His 5-year-old sister and his tuberculous mother still work. I have seen children only 6 years old at work at 10 p. m.

The effect of the work on the physical condition of these children.—Much is being said and written upon occupational diseases, and some attention must be paid to the physical condition of these youngest workers. At their age all parts of their bodies are constantly changing, growing, and developing; the work is performed in rooms built for living purposes, not for manufacturing. All the industries require close attention, giving rise to well-defined eye strain, always a serious condition. The constant bending over the work prevents the development of the chest wall and hinders the expansion of the lungs; the spinal column can not be maintained in the proper position. The capacity for speed becomes used up; the women tell me they must constantly urge the child to greater activity. In the case of the 3-year-old button maker, the mother stated that she could not make the child work longer than two hours at a time. This complaint of lack of speed is a common one; the child is constantly losing its power to accomplish as much in a given time. A few of the women realize that a recess from work is an absolute necessity; that play is as necessary for the mind and body of the child as food is. Indeed, the fact that a child often prefers play to food is well known. I had occasion to speak to a little 8-year-old girl of street dangers, and she answered: "I'll not be run over; I sew the pants at home." These children are being prepared to join the army of abnormal, backward children, and, later, the ranks of future unskilled workers. The children of school age are in an even worse condition than their younger relatives; they must attend school and work at home after school hours, Saturdays, and holidays.

The wages.—The worker in a tenement room can not possibly earn the amount of which she is capable; the actual amount is about one-half of what she could earn at the same work in a factory. This is due to the fact that fatigue comes more quickly; her attention is constantly distracted by the home surroundings and by the necessity of urging on the child workers. She is often obliged to take an inferior grade of work, or, if the work is of the first class, she has the added fear that it will be spoiled. This has been particularly noted among the embroiderers. A child of from 3 to 5 years earns from $1 to $2; a girl of from 8 to 10 can earn $3 to $4 per week at finishing; the average wage of the woman is rarely more than $5 per week. The majority of tenement workers obtain this work from factories. A considerable amount is brought home by those who work in stores and custom-work establishments either to earn, as they say, "a few more pennies" or to finish an order. The pay these tenement folk receive is extremely dear; the price they pay is the stunted bodies and dwarfed minds of their little children.

The evil to the public.—In the light of our present knowledge of the possibility of contracting diseases and of the part insects play in their dissemination, it is evident that there is a distinct danger in tenement-house manufacturing; the ultimate price to be paid is the maintenance of human beings who have exhausted their power of self-support before the normal period. They become old before their time and useless.

The labor bureau, in its report for 1911, states that "15,482 persons are employed in 11,510 apartments." It further states that an army of inspectors would be required to see that the law is actually enforced. The inspector visits these tenements a few moments once or twice a year.

THE REMEDY.

The factory inspector in 1888 transmitted to the New York State Legislature a report of tenement-house manufacturing, and stated: "The remedy lies in strictly prohibiting manufacturing in tenements." Since then, and during the 20 years that the State board of labor has had control, many laws have been made, but the evils continue, at times more acutely than others. The tenement conditions, as they are stated in this paper, I have personally observed for 25 years. My remedy is absolute prohibition of all manufacturing in tenement houses.

HOW AND WHY SMOKE IS INJURIOUS.

RAYMOND C. BENNER, Department of Industrial Research, University of Pittsburgh.

Dwellers in a district where soft coal is burned almost universally condemn smoke. Its injurious effects are well known in a general way. When, however, it comes to certain definite injuries done by smoke, and wherein it is harmful, we find that it is not a matter of common information, and, furthermore, that it has been made the subject of but comparatively few scientific studies, and those not coordinated in the different branches.

Soot is, generally speaking, the solid matter given off during the incomplete and faulty combustion of soft coal, and consists, for the greater part, of carbon, mineral matter (ash), tar, and moisture, together with smaller portions of the sulphur acids (H_2SO_4, H_2SO_3, and H_2S), nitrogen compounds, and occluded gases. This composition varies between the widest limits, depending upon many factors, such as coal, air supply, temperature of furnace, and so forth. The following analysis of soot, made by Cohen, and obtained under different conditions, shows to a certain degree the effect of some of these factors:

Fireplace.

	Original coal.	Soot 5 feet from grate (bottom).	Soot 35 feet from grate (top).
	Per cent.	*Per cent.*	*Per cent.*
Carbon	76.80	36.45	37.22
Hydrogen	4.90	3.51	3.51
Tar	.88	34.87	40.38
Ash	1.80	5.09	4.94

Boiler chimney.

	Original coal.	Bottom.	13 feet from base.	70 feet from base.	Top of 110-foot chimney.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Carbon	69.30	19.24	16.66	21.80	27.00
Hydrogen	4.89	2.71	.86	1.44	1.68
Tar	1.64	.09	.28	.80	1.14
Ash	8.48	73.37	75.04	66.04	61.80

It will be seen by comparing the analyses given that the percentages of tar and carbon are higher in the soot obtained by burning coal in a fireplace than when it is burned under the boiler. This is due, for the most part at least, to the fact that the temperature of combustion is much higher in the boiler furnace than in the grate and other domestic installations. The higher percentage of ash in the soot from the boiler furnace can be accounted for on the same grounds. It is a well demonstrated fact that the losses due to the solid combustible matter in smoke are small, the economy accompanying the proper smokeless combustion of coal being obtained by the complete oxidation of the carbon monoxide and other invisible gases which always accompany the incomplete combustion of coal. Sir Roberts-Austin found, as a mean of some 40 experiments, that 6 per cent of the coal is lost when the coal is burned in domestic grates, while on the other hand Scheurer-Kestener found the loss to be only 0.5 to 0.75 per cent when burned under the boiler, where the temperature of combustion is higher.

Among the minor constituents of soot, the sulphur acids are by far the most important. The amount and kind formed depends upon the factors determining the composition of the soot in general. The following analysis of soot by Cohen and Herford gives an idea of the possible distribution of the sulphur:

	A.	B.
	Per cent.	*Per cent.*
Passing out as sulphur gases	71.78	60.00
Absorbed by soot	14.51	11.88
Left behind in ash	13.71	28.13

The amount of free acid in soot may be quite large, Russel having found as high as 4.9, 2.3, and 7.2 per cent free H_2SO_4, while Cohen and Ruston do not report as large amounts. They find free acid to the extent of 1.62 per cent. Arsenic is also frequently present, but only in small percentages, usually less than 0.1 per cent.

The nature and composition of soot make it the worst possible kind of dirt. It is black; in fact, it is the lampblack that forms the basis of black paints. Its power of absorption is great, giving it the property of occluding large quantities of injurious gases. The tar contained gives the soot the power of firmly adhering to anything with which it comes in contact, while the sulphur acids which it contains corrode most substances. It would be hard to imagine a more objectionable kind of dirt.

A knowledge of the chemical composition and other properties makes the injury which soot does to vegetation evident to one acquainted with plant structure and growth. Soot is detrimental to the healthy development of plants, inasmuch as it (1) blocks the stomata of the plants and stops to a greater or lesser degree the transpiration; (2) covers the leaf with an adherent black coating, which cuts down the amount of sunlight reaching the chlorophyl; and because of (3) the corrosive action of the tar, acids, and so forth. Evergreens, more especially the conifers, seem to be much more easily affected than other plants. On evergreen plants the leaves are exposed to the action of the soot for a much longer time than those which shed their leaves at least once a year. Therefore, they become covered with a thicker coating of soot. The conifers also possess sunken stomata, which act as very effective pits to catch the soot.

One might think that the excess CO_2, which is likely to accompany the soot, would make plant growth more active, but it has been found that the increased percentage of CO_2 is not great enough to be a factor. Cohen compared laurel leaves from four different localties having different amounts of soot fall, and found the relative assimilations to be 100, 52.8, 15.2, and 11.6, respectively, and roughly proportional to the soot fall in these places. In England ash trees have been observed to shed the leaves four to six weeks earlier in the smoky districts than in districts free from smoke.

Trees automatically keep record of their yearly growth by the width of the rings. A section of a Scotch fir noted by Cohen shows the date of the erection of a smoke-producing factory near the tree by the decrease in the width of the rings. Vegetables, such as radishes and lettuce, planted in different parts of Leeds, have been found to be stunted in their growth to a degree nearly proportionate to the soot fall.

The effect of smoke on buildings and building materials is marked and it soon destroys the appearance of buildings which can not be cleaned. In smoky districts, because of the smoke, it is often necessary to modify a design in some respects. Skylights can not be used advantageously, as they soon become coated with the black soot. Drain pipes must be arranged so as to avoid the splashing of water on the walls. Building materials, such as glazed tile, which admit of easy cleaning, are used much more in smoky cities than elsewhere. Granite and sandstone with a siliceous binder form better building materials than limestone and sandstone with a calcareous binder, which is easily corroded by the acid in the soot and rain. Thus the stones which are most easily worked are undesirable in smoky cities. The sulphuric acid acts on the calcium carbonate, forming calcium sulphate, which is more readily soluble than the carbonate, also causing it to swell and become porous and friable as well as more readily disintegrated. Dr. Smith has found mortar to contain as high as 48.16 per cent $CaSO_4$, which was formed by the action of the sulphuric acid in the air, while limestone has been found to contain from 0.52 to 3.85 per cent $CaSO_4$, due to the same cause.

The effect on most metals of the sulphuric acid, occluded in soot, is rather marked and greater than the action of a like amount of acid in the rain water or air. It would seem from observations taken in Pittsburgh that the soot containing acid is made to adhere to the metals by means of its tar content, in which place it acts as the carbon. This, together with the metal and acid, forms an electrolytic couple, making corrosion much more rapid. In case of iron and aluminum the oxide and basic sulphate iron and aluminum the oxide and basic sulphate are produced, at least in part, from the sulphate and the acid is used over and over again. To experimentally vertify these observations duplicate sets of various metals were fastened to two boards. One set was protected from the soot in the air by means of cheesecloth, yet was still exposed to the air and rain. The other set was left unprotected. The pieces of metal left unprotected from the soot show a much greater amount of corrosion than those which were protected.

I wish here to call your attention to the following figures obtained by Messrs. W. B. Worthington and A. Rattray, showing how corrosion is accelerated by the acids in the air. Quoting from Cohen: "A number of rails were placed in suitable positions by the side of the line and weighed at intervals, and the loss in weight recorded." The rails were of the ordinary railway section, weighing 86 pounds per yard. The annual loss of weight from corrosion was as follows:

	Loss in weight in pounds per yard.	Number of years of observation.
1. In the center of the town	1.04	17
2. On the seacoast among sand hills	.18	17
3. In a dry place in a smoky tunnel	1.48	13
4. In a wet place in same tunnel	1.71	8

The question of exterior and interior decoration is one affected as much by the amount of smoke in the air as by the tastes of the owners of the buildings. Interior draperies and paper are soiled much quicker in a smoky city than elsewhere. If light paper is used in papering the rooms, it must be cleaned every six months, and new paper put on at least once a year to keep it looking only half as well as it would in a smoke-free city.

The effect of soot on paint is in most cases a matter of appearance only. The time which it takes to spoil the paint depends, of course, on the amount of soot in the air, color of the paint, and tar and acid in the soot. The number of paintings necessary in a given time depends on the above factors, as well as upon the fastidiousness of the owner. In some cases the soot seems to act as a protective coating, while in others it has a corrosive action, destroying the surface gloss and rendering the surface more easily weathered.

Soot in the air of cities has a marked effect on the weather in a number of ways. By (1) cutting off the light; (2) increasing the duration of fogs; (3) making the minimum temperature higher.[1]

As is well known, finely divided carbon, in the form of lampblack, has the property of cutting off sunlight to a greater degree than most other substances. It is not surprising, then, to those of us who are acquainted with the soot clouds hanging over large cities that the duration of sunshine has been found to be decreased 17 per cent, while if diffuse daylight is considered, the loss is even greater. Cohen finds, as an average of a large number of determinations made both in summer and winter, that fully 40 per cent of the light is cut off by the smoke cloud and that the amount of light varies inversely as the amount of soot in the air. Dr. Russel states, in his article entitled "London Smoke and Fog," that the amount of soot in the air varies greatly with the weather, and gives the following figures to bear out his statement: Fine weather, 0.0035 grams per 1,000 cubic feet air; dull weather, 0.0103 grams per 1,000 cubic feet air; foggy weather, 0.0244 grams per 1,000 cubic feet air. The amounts of CO_2, H_2S, and SO_2, together with the other gaseous products of combustion, also increase.

It may be said that each particle of moisture in a fog is formed or condenses around a solid nucleus or a dust particle. (This does not take account of ions, which are probably not of great importance in fog formation.) For this reason fogs might be thought to be of more frequent occurrence in the city than in the country. This is, however, not necessarily the case, and, as a matter of fact, dust particles for the formation of fogs are sufficiently numerous in the country as well as in the city. Smoke does, however, increase the blackness of a fog, making it much denser than the country fog, simply on account of the black soot particles. The fog is also apt to be of longer duration because of the oily tar in the soot which forms a film over the outside of the drop, thus protecting it from evaporation. It is said that at least 20 per cent of the London fogs, between September 1, 1902, and March 31, 1903, were artificially induced and preventable. The amount of soot which falls on any area during a given amount of time forms a subject of interest to the public at large as well as to the scientist. Cohen finds the air in dull weather to contain 0.0119 grams of solid matter, which he assumed to be soot, as it is always black, and these figures agree well with Russell's for dull weather. In Pittsburgh I find that the amount of soot in the air corresponds remarkably well with the figures for the English cities.

Numerous measurements of soot fall have been made in as many different ways by collecting rain and snow and by catching the dust in various forms of vessels:

Place.	Weight in tons.	Area in square miles.	Time.	Method of collecting.
Manchester	30	100	1 winter	Snow fall.
Glasgow	820	1	1 year	Boxes.
Leeds:				
Industrial	539	1	do	Snow and rain.
Residence	26	1	do	do
London	195–650	1	do	Soot gauge.
Indianapolis	600	1	do	Snow.

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[1] H. H. Kimball: unpublished paper.

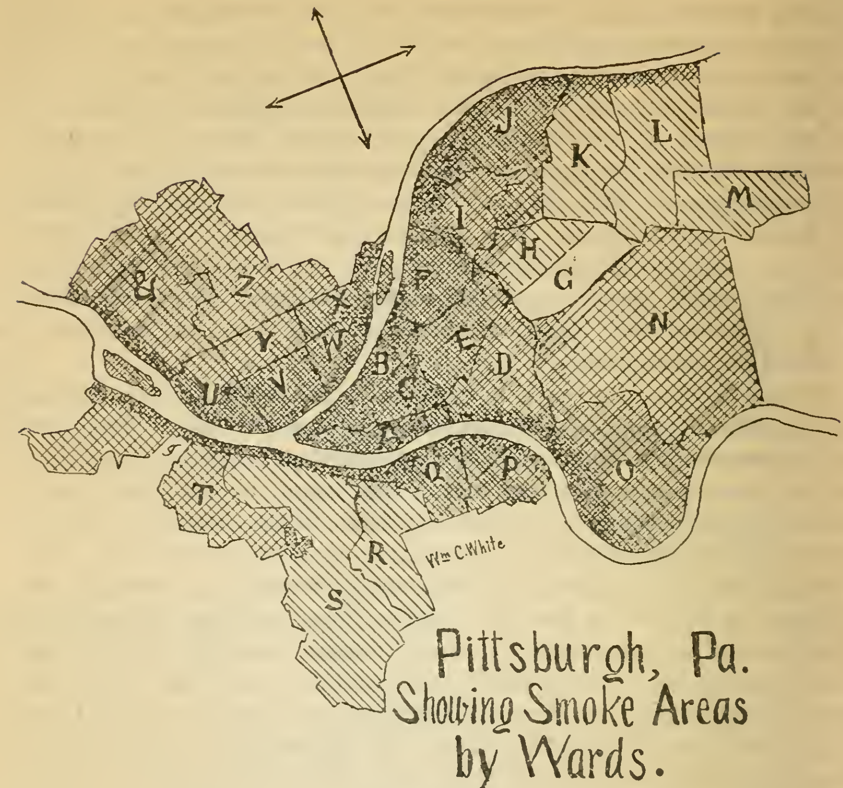

Chart I.

A STUDY OF THE INFLUENCE OF VARYING DENSITIES OF CITY SMOKE ON THE MORTALITY FROM PNEUMONIA AND TUBERCULOSIS.

Wm. Charles White, associate professor of medicine, University of Pittsburgh; and C. H. Marcy.

As part of the investigation into the smoke problem, which is being carried on at the University of Pittsburgh, through the generosity of Mr. R. B. Mellon, we have made a study of the influence which varying densities of smoke have on the mortality from tuberculosis and pneumonia as typifying acute and chronic pulmonary infections. Perhaps in none of the smoky cities of the world is it possible to go into the influence of smoke in the same way as in Pittsburgh. The peculiarity of the relation of high hills and valleys, in close proximity, within the city limits, makes a well-defined variation in the smoke content of the air. It will be noticed on the map (chart 1) that, along the river frontage, where for the most part the land is low-lying, the air content of smoke is very dense; skirting this dense smoke area, the hills rise more or less abruptly to varying heights. On the lower hills, as exemplified by C, D, E, J, Y, Z, and &, there is an area of moderate smoke density. Where the hills, however, rise directly from the river to the height of 400 or 500 feet, as exemplified by R, S, T, G, K, L, N, and M, there is comparatively little smoke at any time of the year. During prosperous times, the valley, or dense-smoke area near the rivers, is always heavily laden with smoke. This is true even when there is a brisk breeze blowing.

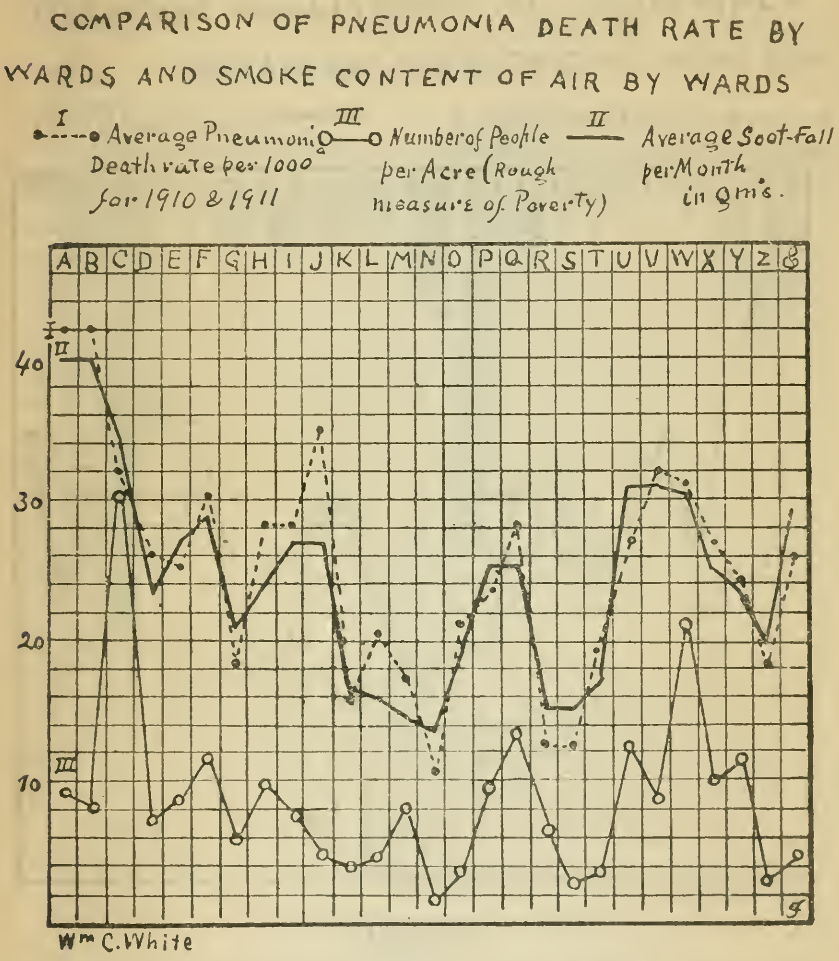

CHART II.

It is possible, from the division of the city into wards, to rule out a number of other factors, such as poverty, race congestion, and so forth, as an influencing factor in the point of relation which we have brought out by these studies.

It is unfortunate that our figures only cover a period of two years, but this is due to the fact that no records taking account of the wards of the city have been kept prior to this time and also that the number of wards was changed from 56 to 27 three years ago. This renders useless any previous comparison on the ward basis.

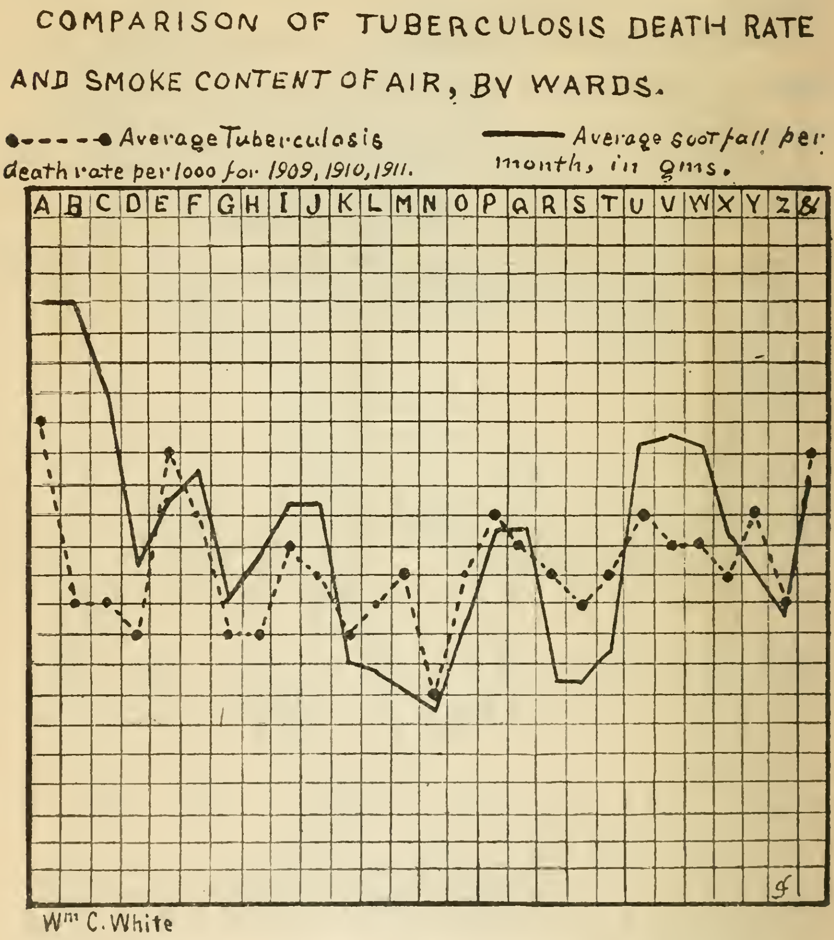
COMPARISON OF TUBERCULOSIS DEATH RATE AND SMOKE CONTENT OF AIR, BY WARDS.

CHART III.

The figures which we have obtained are, from one aspect, very convincing, although from another aspect very confusing. It will be noticed, for instance, in Chart 4, that in Chicago, where there is a comparatively low smoke content, there is still a very high pneumonia death rate; while in Pittsburgh, with the highest smoke density, there is no higher pneumonia mortality.

The question of smoke density for the various cities has been based upon the reports of the United States Government Weather Bureau.

In the various cities which are included in this report the method of determining this density is based on the distance of vision, considering certain fixed objects in the city from an observation center. In Charts 2 and 3, of Pittsburgh, the basis has been certain carefully de-

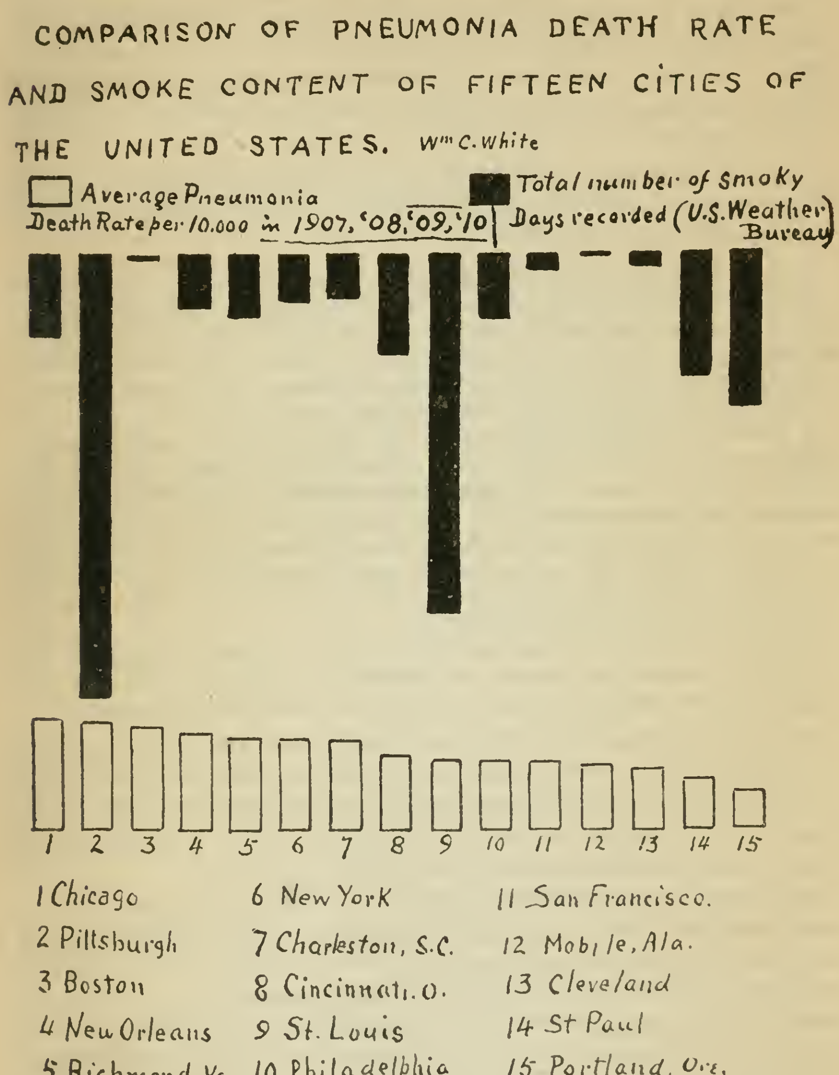

CHART IV.

vised studies of precipitation of air content of carbon dust. These scientific observations have been made in connection with the present smoke study by Messrs. R. C. Benner and C. H. Marcy. In Chart 4, for the sake of comparison, we have adhered to the Government Weather Bureau report.

The mortality tables, on which Charts 2 and 3 are based, were derived from the health table of statistics of the city of Pittsburgh, and include the years 1910 and 1911.

The mortality tables for pneumonia, on which Chart 4 is based, were secured from the Bureau of Census statistics.

We desire to acknowledge here the courtesy and kindness of Director Durand, of the Government Department of Commerce and Labor, for the prompt return of the smoke studies and statistical tables from the various cities, which we scarcely could have obtained without his aid.

Since 1905, Ascher, of Königsberg, has published tables and studies on the relation of smoke to pneumonia and tuberculosis. Ascher's main conclusions are as follows:

> 1. The deaths from acute lung diseases are most frequent in children and old people. There is, from year to year, a steady increase in the number of these deaths. This is explained, in part, by the increased contamination of the air by smoke, because the increase in the number of deaths is greatest in districts of an industrial character and not in farming districts. Since 1875 the deaths of infants from pneumonia have increased 600 per cent.
>
> 2. There is a noticeable difference in the deaths, of acute lung diseases, in those industrial districts where smoke contamination is greater than in those industrial districts where the smoke contamination is less. The number of deaths in coal workers from acute lung diseases is 130 per cent higher than the number of deaths in other workmen from the same cause and of the same age. Hand in hand with the increase of acute lung diseases there is a decrease in the age at death from tuberculosis. This means that the fatal course of tuberculosis in smoky districts is shorter.
>
> 3. Animal experiments show that the inhaling of smoke increases the susceptibility of animals to infection by aspergillus. Pneumonia develops in animals which have inhaled smoke more easily than in the control animals.

Ascher's experimental work can scarcely be used as a comparison with the influence of the smoky atmosphere of cities, because he used the smoke or soot of burning petroleum, which forms an insignificant amount of the smoke content of cities and differs very materially from the main content of the smoke of city air.

So far as Ascher's statistical tables are concerned, there can be very little doubt that acute lung diseases are taking a different course to tuberculosis, and one of the most appalling things of modern civilization has been the sharp increase of the mortality rate from acute diseases of the respiratory tract coincident with industrial activity and the consequent provocation by smoke of the respiratory tract, this being in sharp contrast to the diminution of the chronic diseases of the respiratory tract, as exemplified by tuberculosis.

The pneumonia death toll for 1900 for the United States was 105,971; for 1909, 122,400; and for 1910, 136,000; an increase of 10 per cent in one year.

The average death rate from tuberculosis per 100,000 for the 10-year period 1900–1909 was 183; in 1909 it was 160.8; and in 1910, 160.3. This shows a steady decrease.

These figures are examples of the merit which this subject has for our most earnest study.

The chief fact which has stimulated our interest in the pneumonia problem in the city of Pittsburgh has been the terribly acute and fatal type of pneumonia which fills the wards of our hospitals. It can hardly be that this severity of infection has to do alone with the virulence of the germ; nor does it seem likely that it has to do with the generally low type of resistance which Pittsburghers have to this type of infection; rather, it seems more likely that there must be some factor present in Pittsburgh which does not operate in other cities. As we approached this subject we felt sure that we would be able to prove that this factor was the smoke of the iron and steel mills. How signally we have failed in this will be very evident from chart 4, in which is seen the striking contrast between Boston, with almost no smoke, and Pittsburgh, swamped with smoke, yet with approximately the same pneumonia death rate. The same sort of thing is apparent between Mobile, Ala., with almost no smoke, and St. Louis, Mo., with a very high smoke content in its air.

When we attempt to analyze the city of Pittsburgh on the basis of air content of smoke and pneumonia death rate, so striking is the correspondence between the pneumonia death rate and the smoke content of the air of the ward that we are convinced that smoke is a very important factor in the severity of the disease and that some other factor must operate in those cities where the smoke content of the air is not the determining factor in the pneumonia death rate. This correspondence is more striking even when we put in a line showing that there is no definite bearing of such other factors as poverty, race, and congestion. When, however, one turns to tuberculosis and analyzes the death rate from this disease by wards and charts it up in comparison with the smoke content of the air, one finds that there is comparatively no association whatever. This corresponds with our clinical observations on between four and five thousand cases of tuberculosis in the last six years. As the result of this clinical study we have come to the conclusion that the general death rate from tuberculosis in Pittsburgh is low—that there is nothing in the smoke content of the air which in any way stimulates the onset of the tubercular process or militates against the rapidity of recovery from tuberculosis when once this disease has been contracted.

In other words, after having made an analytical study of the relation of smoke in the city of Pittsburgh, where it is possible, by virtue of its contour, to separate the atmosphere into "densely laden," "moderately laden," and "comparatively no smoke" areas, and in such a way as to rule out such influences as poverty, race, and congestion, we are forced to the conclusion that the smoke content of the air has an apparently important bearing on the pneumonia death rate and comparatively little bearing on the tuberculosis death rate.

From the careful analytical studies of the character of the smoke in the city of Pittsburg, carried out by Dr. Klotz and Dr. Holman in connection with this same work, there is added a purely chemical and physical reason for this same conclusion, for they have found that the percentage of phenol around the carbon, which pollutes the air, is sufficient to destroy most or many of the organisms with which they have studied when suspensions of these are mixed with suspensions of air smoke.

With this fact in mind it is probably legitimate for one to turn to the pathological studies of these two infections. Pneumonia is a catarrhal condition, and a predisposition for it may be prepared by the irritation of the mucous membranes with foreign substances; but the second (tuberculosis), being granulomatous in type, in which the microorganisms are sequestered and surrounded by cells, the cure of which is accomplished by fibrosis, may naturally be supposed to be aided in the direction of cure by any deposit which stimulates granulation and fibrosis. Some strength is given to this theoretical view by the evidence which we have from anatomical studies, in which we find depositions of carbon particles around the healed tuberculous focus.

One can not help wondering why, when the facts concerning these two diseases are known, so little has been done on the question of pneumonia prevention, when so much has been accomplished on the tuberculosis side of pulmonary infection; and, in addition to my remarks upon the relation of smoke to this disease, I should like to again call attention to certain suggestions which I offered a year ago in an address before the Ontario Medical Association for the control of a certain portion of the evils arising from pneumonia. These are as follows:

First. The proper segregation of pneumonia patients and their utensils in hospitals; cleaning, by sprays and washes, of the noses and throats of all who nurse and come in contact with these patients; careful hand washing of nurses and attendants after handling; careful destruction of sputum and other discharges; sterilization of linen of patients; fumigation of rooms after occupancy; and the use of gauze, which can be burned, instead of handkerchiefs. These will be the center of the educational crusade.

Second. To have attached to our dispensaries certain nurses who have received special instruction on nursing and preventing the spread of pneumonia, these to be sent to all pneumonia cases in home-nursing work.

Third. The reporting of all such cases to the health department governing the district where the disease exists and the fumigation of the quarters in which the disease has occurred by the department after the death or recovery of the patient.

Fourth. The instruction of the public by pamphlets and school lectures on the necessity for keeping the noses and throats cleansed, especially during winter months; the necessity for controlling the dust of streets by better sprinkling and night sweeping; the evils of bad ventilation in house, public building, and school; of alcohol; of badly cooked, poor food; of lack of rest; of worry; of the handkerchiefs; of the bearing on pneumonia of spitting, as well as on other diseases; of the increased resistance generated by open-air sleeping; and similar knowledge. This, I am sure, can best be engrafted on the child's mind rather than on that of the adult.

A PSYCHOSIS FOLLOWING CARBON-MONOXIDE POISONING, WITH COMPLETE RECOVERY.

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Among the various toxic psychoses which have come under my observation in the Government Hospital for the Insane, one which was produced by carbon-monoxide poisoning is of special interest, in view of the fact that the patient suffered from a severe intoxication which resulted in the development of mental symptoms one month following the accident and terminated in a complete recovery. That psychic disorder is one of the sequelæ of this form of poisoning has long been recognized, yet few cases have been recorded in this country. A careful review of the literature yields scanty information as to the clinical and pathological course of this toxemia, notwithstanding the many accidents which occur in our large cities and collieries. However, some valuable observations on this subject can be obtained from foreign publications.

Cases of carbon-monoxide poisoning may be accidental, suicidal, or homicidal, or the latter two may be combined. In France, four-fifths of the suicides are caused by poisoning with carbon-monoxide gas. In the large cities of this country, scarcely a day passes without a number of cases of accidental or suicidal intoxication from this gas being reported in the newspapers, and still there are no available statistics of these accidents or fatalities. In the last bulletin of the United States Census Bureau on "Mortality Statistics" deaths from this source are not grouped independently, but are included under the general head of "Mortality from intoxications."

This gas may be produced in houses by defective combustion in the various forms of heating apparatus, particularly in movable stoves, charcoal braziers, or slow-combustion stoves. Since carbureted water gas has been used as an admixture to illuminating gas the danger to life by defective gas fittings and gas stoves, as well as from the mains in the soil, has increase, and accidental deaths and suicides have multiplied enormously, according to Gleister, of Glasgow. Another source of danger from this gas has arisen in recent years from the extensive use of benzine and gasoline explosive engines which are installed in the motor car, motor boat, and aeroplane. Investigations following accidental death from the gas escaping from such engines revealed the fact that the men attending the engines in the cabins of launches often have toxic symptoms—headache, dizziness, and so forth. In this connection it is the opinion of Surg. Gen. Stokes, of the United States Navy, that the noxious gases generated by exploded powder in the turrets, from burning coal in the firerooms, and other causes are similar to carbon monoxide in illuminating gas, and are responsible for the collapse and sometimes the death of men working on warships, phenomena heretofore ascribed to the effects of intense heat.

Carbon monoxide is a constituent of mine air, when explosions occur, and of the gas of blast furnaces. This form of poisoning may occur in many other occupations, and it is therefore a matter of importance in industrial pathology. In view of the above facts, it is surprising that more frequent cases of nervous and mental disorders following this intoxication have not been recorded in America, where so many fatal mine explosions occur and so many deaths result from illuminating gas. Many of the States have recently appointed commissions to investigate occupational diseases, among which was included this form of poisoning. In 1909 these commissions united as a permanent organization, known as the National Conference upon Compensation for Industrial Accidents.

The Bureau of Commerce and Labor issued a bulletin in 1910 on "Fatal Accidents in Coal Mines." This report furnishes no information concerning the effects of such intoxication upon those who escaped death. A revised list of industrial poisonings has recently been published in German by the International Association for Labor Legislation, and its translation in full is given in a bulletin published by the Department of Commerce and Labor in May, 1912. Included in this publication is an interesting summary on carbon monoxide, the designation of the substance, the branches of industry in which the poisoning occurs, the mode of entrance into the body, and symptoms of the poisoning.

Ziehn mentions a chronic monoxide poisoning which affects those employed in laundries as ironers, firemen, and others who work in crowded overheated places in which there are bad heating arrangements, and in which these people are obliged to remain for some considerable time. It manifests itself in general nutritional disturbances, and presents a picture of mental and bodily fatigue which is sometimes regarded as either neurasthenia or hysteria.

The following is the clinical record of the case:

Case 18888, M. A. O., admitted December 10, 1910; native of Ireland; single; age, 45 years; indigent.

The following history was supplied by an aunt of the patient, with whom she made her home. After the patient's return to her normal mental state she corroborated this information:

Family history: Negative, so far as could be learned, as to nervous or mental diseases, epilepsy, etc.; mother died of tuberculosis at the age of 30 years.

Personal history: Born in Ireland; was elder of two children; always healthy; common-school education. After her mother's death, kept house for her father until she came to this country, at the age of 28 years. Upon her arrival in this country she obtained employment as a domestic, and was evidently an efficient servant, as she was employed for a number of years by prominent families in this city, among whom was a United States Senator and a German ambassador. She was of a cheerful disposition, habits good, and always attended to her religious duties. Was fond of reading history, fiction, and periodicals. On November 2, 1909, she went to bed in her usual good health, and on the following morning was found in a deep coma. Upon investigation, it was found that illuminating gas was escaping from a defective gas fixture in the room which she occupied for the first time upon her return from her vacation, not knowing that the stopcock was broken, though this fact was known by the other servants in the house. Had it not been for an open window, the accident would have been fatal. She was at once removed to the George Washington University Hospital, where she remained in an unconscious condition for four days. The informant called on her four days after the occurrence, but at this time was unable to arouse her. However, on the sixth day the patient recognized her, although she was dull of comprehension and appeared somewhat somnolent. From this time on patient daily improved, and was discharged on November 13, 1910, having recovered from the acute effects of the poisoning.

Abstract of record from the George Washington University Hospital, where she was first taken immediately after the accident: Admitted to the George Washington University Hospital on November 3, 1910. For the first 24 hours patient's temperature fluctuated between 101 and 100; pulse between 120 and 82; respirations, 40 and 22. Was given oxygen on admission, and normal salt solutions frequently, at least every four hours; hot applications externally. Patient began to perspire about three hours after admission. She was given oxygen every hour for a short time. Hypodermoclysis of 500 cc. was given.

Summary at end of first day: Nurses' notes—Was catherterized. Patient perspired a great deal. Hot bottles, oxygen every hour for 15 minutes during the last 18 hours. Patient turned on her side for a half hour during the night.

Summary at end of second day: Maximum temperature 101; minimum, 98.6; pulse, 100 to 80; respirations, 30 to 24. Oxygen given every hour for 15 minutes. Hot applications, normal salt injections. Nurses' observations: Patient restless all night; seemed more rational.

Summary at end of third day: Maximum temperature, 100; minimum, 99; pulse, 100 to 70; respiration, 30 to 24. Oxygen given. Saline solution discontinued. Patient conscious at intervals; slept very little; complained of pain in back; very restless all night; slept at intervals.

Summary at end of fourth day: Temperature, normal; pulse, 78 to 70; respirations, 26 to 24. Patient restless all night, complaining of pain in back and neck; slept about one hour. Patient tossed about the bed; got out of bed.

Summary at end of fifth day: Maximum temperature, 98.8 to 97.8; pulse, 80 to 78; respirations, 28 to 24. Patient very quiet during the day; restless all night; complained of pain in back; asked to get out of bed. Slept from 1 o'clock on at intervals.

Summary at end of sixth day: Temperature, normal; pulse, 80 to 74; respirations, 24. Patient very restless all night; complains of pain in the back; wanted to get out of bed. Slept about three hours.

Summary at end of seventh day: Temperature, normal; pulse, 80 to 74; respirations, 24 to 22. Patient very restless all night; slept about four hours during the night; very nervous. Given regular diet; eats well. Voided urine.

Summary at end of eighth day: Temperature, normal; pulse, 78 to 76; respirations, 24 to 22. Patient very restless; slept about four hourse during the night; very nervous. Given regular diet; eats well. Voided urine. Patient sat up in chair during the day.

Summary at end of ninth day: Temperature, normal; pulse, 80; respirations, 24. Patient up during the day; walked about; slept well.

November 13, 1910, tenth day, discharged.

Upon her return to her aunt's home she continued to improve, and after two weeks was allowed to go back to the place where she had been working, as relatives and friends at this time considered her well. Soon after she resumed her duties the servants with whom she was associated noticed that she was becoming dull and forgetful about her work. She gradually became worse and, on this account, at the end of a week she was taken back to the home of her aunt, where she remained until her admission to this hospital.

While at her home, one week later, her aunt observed that her actions were peculiar, her movements were very awkward, and her memory seemed to be a complete blank. She had outbursts of laughter without provocation; did a great many irrational acts—for instance, one day she was noticed trying to put the trousers of a little boy on for a waist. She put her hands through the legs, and tried to pull the trousers over her head. She was unable to find her way about the house. One day she wandered from her aunt's house to the United States Treasury Building, where she accosted a policeman, and told him that she was in search of the house on U Street where she was formerly employed. She was directed to the residence and found her way there safely. A few hours afterwards she was again taken back to her aunt's home. At this time she was oriented to person and place, but could not tell the hour, day, month, or year. Was unable to attend to her personal wants, became very untidy, would not remain in bed, and finally passed into a state of confusion and was brought to this hospital December 10, 1910, 38 days after trauma.

On admission to this hospital, December 10, 1910, the patient was in a semi-stuporous condition; would answer questions promptly; was able to give her name, but all other replies were incorrect and irrational. She extended her tongue when told to do so, but otherwise was unable to carry out the simplest orders given her; was spoon fed, as she was unable to feed herself. Throughout examination patient showed causeless laughter.

Physical examination: Patient was in bed; well-nourished white woman, height 5 feet 2½ inches, weight 120 pounds; masklike facial expression; hair dark brown, mixed with gray, fine in texture; slight lateral scoliosis; deformity of sternum at articulation of the gladiolus with the manubrium; ears small; right antihelix more prominent than the left; feet calloused, metatarsal phalangeal articulations prominent; complexion sallow, superfluous hair on face; skin free from eruptions; mucous membranes moist and pale; tongue coated, eroded on tip, gums inflamed, marked pyorrhea alveolaris, breath foul; appetite poor; bowels regular; heart normal in outline, slight presystolic murmur over apex; protruded tongue showed slight tremor; pupils equal, reacted promptly to light and accommodation; knee jerks exaggerated, right greater than the left; plantars diminished; anesthesias over the whole surface of the body, including the face; she showed no reaction to deep pin pricks, although this may have been due to some extent to the mental dullness. She could not recognize heat or cold when applied to the surface of the body, nor was she able to distinguish the gustatory tests used—salt, sour, sweet, or bitter; called a solution of quinine, when placed on her tongue, sour; unable to recognize any of the olfactory tests; said peppermint was bitter; cloves, didn't know; called stench hartshorn; astereognosis present; grip, right hand 14 kgs., left hand 9½ kgs.; coarse tremor of extended hands; gait unsteady and uncertain; balancing power impaired; involuntary evacuations of the bladder and bowels; urinalysis negative, no sugar, albumin, or casts.

Wassermann reaction, with the blood serum and the cerebrospinal fluid, negative. Cerebrospinal fluid, clear; protein content not increased; Noguchi test, negative. Cell count 1 per cmm. Differential; lymphocytes 98; large mononuclears 2.

The notes made for the next three days showed that mentally the patient was dull and apathetic; responded promptly to all questions, but was able to give little additional information in regard to personal matters; gave name of the country in which she was born, but could not give the name of the county or parish. Her replies were irrelevant, and accompanied by outbursts of laughter. This tendency to laughter was also shown when she heard the voices of anyone around her, or whenever anyone approached the bed. She had a mistaken identity of all persons in her environment, although she recognized her aunt on her visits. She appeared mentally clearer, in so far as she was able to comprehend and carry out simple orders given, although there was a retardation and some incoordination in all her movements. When asked where she was, she said she was at home, but that she had just been down the river on a boat with President Taft and his daughter Helen. At this time she carried out the following orders after considerable hesitation: Right forefinger on left ear; right hand on left knee; left hand on right knee.

The neurological symptoms above mentioned still continued; deep reflexes all exaggerated. At this time there was present on both sides a wrist clonus, also a slight Babinski; anesthesias were still present, but there was an area on the inner side of the right thigh just above the knee about the size of a silver dollar which showed a delayed reaction to pin pricks.

The following is an abstract of the clinical notes for the next 10 days, from December 15 to 25:

Consciousness still clouded. She gave prompt replies to all questions, but still showed a tendency to confabulate; on one occasion she said she had just returned from the Bureau of Engraving and Printing; that she was employed there, and again that she had been at her home.

As a rule, all replies were incorrect. Said she was born in Ireland, but, when asked in what county, said, first, County Limerick and then County Mayo, when in fact she was born in County Clare. Still had a mistaken identity of persons, and showed uncontrollable laughter. Whenever she heard anyone speaking near her, she laughed heartily without cause. She continued to have incontinence of urine and feces. At this time she was able to comprehend and carry out simple orders as follows: Right forefinger on left ear; right heel on left knee; left heel on right knee; all movements were unsteady and ataxic. Rhomberg present; gait unsteady; marked Babinski. All deep reflexes were still exaggerated; there was marked clonus of both wrists and ankles on both sides. Anesthesias were not so marked; she was able to recognize deep pin pricks on almost all parts of the body, but could not localize light pin pricks.

During the next five days the patient showed some improvement. She had learned the names of two physicians, the head nurse, and two noisy patients in the ward, but was unable to identify them. She was disoriented to place and time. She was at this time able to give the names of one or two of her employers, the name of the church she attended in the city, the correct county and parish in Ireland in which she was born, and gave correctly the names of her relatives in this city and in Ireland. Falsification of memory continued. Said she was at the Y. M. C. A., and had just returned from the city.

The deep reflexes continued exaggerated; ankle clonus and wrist clonus present, also Babinski; anesthesias were not as prominent as formerly; patient responded to light pin pricks on face, hands, and inner sides of her legs and thighs.

During the next five days, from December 30 to January 5, patient continued to improve, especially on the physical side. She appeared to be able to comprehend all instructions given her, but her movements showed inhibition, and it was only with much effort on her part that she was able to cooperate. When told to put her right forefinger on her left ear, she put her right forefinger on the right ear. When asked if that was correct, she said, "No, you said my left ear." She then placed her left forefinger on her left ear. When asked to extend her right hand, she extended her left hand. When told to extend her right and left foot, she did so correctly. After five minutes these orders were again repeated, and this time she failed on all. She still showed some impairment of the stereognostic sense; she recognized a number of objects placed in her hands, but failed in several others. The physical examination at this time showed sordes of the teeth and tongue, and mild gingivitis. Patient was hyperalgesic to pin pricks of the face and ears, the nipples, sacral region, and soles of the feet. After much experimenting, she recognized light touches of cotton wisps. Thermic sense appeared normal over the entire body; gustatory sense normal. Olfactory: Said camphor was smelling salt; stench, pleasant. Equality of grip, 10 kg. each. Reflexes: Triceps and radials and ulnars markedly exaggerated; knee kick exaggerated with slight clonus; plantar and tendo Achilles present; no defense reaction from the feet; jaw jerk present; abdominal absent; Babinski on both sides; slight Romberg present; gait ataxic; tongue, eyelids on closure, and extended hands show tremor; tongue deviated to the right side. Five days later patient was up and dressed; was able to feed herself and had control of her sphincters; said she was living in the Capitol Building; that she had been living here five years; said she was not insane, but had a weakened mind from taking gas.

For the next 10 days, up to January 20, patient improved both physically and mentally; showed orientation, but was unable to recall any of the occurrences in her life for the past two months; assisted with work about the wards. She could recall all the principal events of her own life up to the time of the accident, but showed an anterograde amnesia for subsequent occurrences.

From this time on the patient improved rapidly; had insight and reacted normally to her environment. A mental examination at this time, about February 1, showed that she had recovered her mental faculties, but there was an anterograde amnesia covering a period of three months.

As she was in poor physical health, she was retained in the hospital until April 7, when she was discharged as recovered. The physical examination on that date showed the following results: Patient recognizes pin pricks and light touches all over the body; thermic and stereognostic senses normal; olfactory and gustatory senses normal; no Romberg present; no Babinski; pupils respond sluggishly to light and accommodation; sympathetic scarcely visible; right and left triceps very active and exaggerated; radial and ulnar present; right knee kick exaggerated; tendo Achilles diminished; plantar reflexes very slight; no defense reaction. Patient did very well in performing the above tests. She was willing to cooperate; her reactions were inhibited.

If one seeks in the literature analogous cases of physical disturbances from carbon-monoxide poisoning, very few will be found, and the information given is meager. What strikes the attention most forcibly, when the cases are compared, is that almost every case has its own stamp, and each one presents a clinical picture different from the others. Le Deseeu[1] has collected a number of cases in which the following mental disturbances followed: Aphasia, acute delirium, transitory chronic delirium, mental confusion, amnesia, melancholia, and dementia. And on the physical side he found muscular paralyses of diverse types: Hemiplegias, paraplegias, and monoplegias, various tropic disorders, convulsions, and so forth.

The mental condition of this patient, on first observation, was one of deep confusion. She answered questions readily, as one in advanced stages of senility is apt to do. All answers were accompanied by silly laughter, and none were correct. However, the examination of the patient during the first few days showed that there was a lack of power of attention and concentration which prevented intelligent conversation, and made her replies unreliable and incorrect, and the product of her own imagination.

The principal manifestation of psychic disturbance in these cases is a loss of memory. The amnesia produced by oxide of carbon poisoning is generally sudden in its appearance, and not slow and progressive, like traumatic or alcoholic amnesia; it is a characteristic symptom appearing suddenly, extinguishing at once the entire past, and reducing to almost nothing the perception of the present surroundings. It may be the only apparent symptom in a mild case of poisoning and may soon disappear, or it may be accompanied with disturbances of attention. The amnesia may simulate Korsakow's syndrome in the polyneuritic psychosis with confabulation, pseudoreminiscences, and so forth. A defective memory may exist in a certain number of cases which recover. This amnesia is retrograde or anterograde in type; it is variable in course and intensity; in some cases it is transitory, lasting often only a few hours or days; in others, it persists for months or years; or it may be continuous, and, again, it may require the use of memory exercises to produce any results. In this patient it lasted nearly three months, blotting out this period from her life. More than one month elapsed from the time of the accident until the mental symptoms developed, or, at least, were recognized, and the patient was admitted to this hospital. We are unable to determine from information received how much her memory was affected after the acute effects of the poisoning had run its course. If there was a defect present at that time, it was not apparent to her friends and relatives with whom she came into daily contact. When she gradually began to regain consciousness in this hospital, she had a complete retrograde amnesia which included her past life. After several weeks, the retrograde amnesia gradually disappeared, and she then showed anterograde amnesia only; that is, for the time of the accident, and subsequent thereto. The patient was able to recall the details of her life the day before the accident, but she could not recall any of the events occurring from the time she fell asleep in her surroundings on the evening of November 2, until the middle of the month of February, when under treatment in this hospital. After her recovery, the total period of amnesia was three months.

Sachs,[2] who has compiled a treatise concerning these complications, says:

> "In the early stage of convalescence a total amnesia is especially typical, either extending over the time before the poisoning, i. e., retrograde, or to the things of the present, i. e., anterograde."

The falsifications of memory which were noted in our case during the first month are suggestive of Korsakow's syndrome. These were present to a very marked degree. Stierlin mentions this symptom in two of his patients. In the reports of these cases, one finds the various forms of amnesia diversely associated. Le Desseur cites Brouardel's case of a physician who, following an incomplete intoxication, lost his memory totally. Arriving at his patient's house, he forgot her name, and the course of the illness in her case. This amnesia lasted 18 months, at the end of which time he fully recovered. In his study Le Dessuer also mentions a lithographer who was amnesic to such a degree that he was obliged to consult an indicating board in order to recall the colors that should be applied to each part of the plate. M. Bricard reports a case of a very decided retrograde amnesia. A woman of 21 years of age attempted suicide. The amnesia was complete in all that related to her attempted suicide. She knew of it because she was told of it, but doubted it very much. As to events immediately preceding the attempted suicide, there was found amnesia for at least one week.

Many writers call attention to a marked aphasia in this intoxication, although sometimes it is mentioned as a simple trouble of speech in the form of an embarrassment or of stuttering. This apparently is not a true aphasia, but may rather be designated an amnesic aphasia, since, with the disappearance of the amnesia, the aphasia becomes less marked, or disappears altogether.

Sometimes, in coming out of the coma, there appears an acute transitory delirium which may last a few hours, accompanied by an excitement in which the patient is euphoric to a degree. This delirium is rarely accompanied by hallucinations, but in chronic intoxications the delirium is more prolonged and is accompanied by various hallucinatory disturbances which may be accompanied by delusions of persecution. In the acute stage, this patient showed no delirious experiences of any description although according to Sachs, these delirious conditions belong to the first stages of the poisoning.

Kraepelin[3] states that when those affected first awake from the sleep of the poisoning, in some cases there is an interval free from any disturbance, which lasts many days, or weeks, and then suddenly or gradually the severe symptoms of the disease manifest themselves. Some cases have been followed by relapses. In this connection Weidner[4] says:

> "It is not possible to separate in a sharp manner the after phenomena from the acute symptoms, for in most cases the source of the same extends back to the actue stages, with the exception of a few phenomena of special brain affections, which appear after a free interval, or become manifest after such an interval; and, secondly, the boundary between the disturbances which must be ascribed to the acute poisoning and those which are to be understood as after phenomena are so labile that up to the present there appears to be no unity of opinion concerning them."

The case under discussion showed such reaction to the effects of the intoxication, for after the actue symptoms had subsided, she was about her usual duties for at least 10 days or 2 weeks before the mental symptoms became evident. Abrahamson[5] gives a similar case in which a patient of his was comatose for two days following an acute intoxication from illuminating gas, after which time her intelligence returned. and she went home. Two weeks later she developed a psychosis.

A marked reduction in the emotional field in these cases has been observed by many writers. Recently Pfeifer has called attention to a singular phenomenon which often attracts attention in poisoning from coal gas, and that is the fixed, masklike expression of the face. The emotional tone of this patient for nearly two months was one of indifference. There were abrupt outbursts of an irresistible tendency to laughter. These outbreaks were spasmodic in character and occurred without provocation. All her replies were accompanied by this causeless laughter; it was evident whenever anyone approached her bed. This emotion was not deep, as she laughed when a patient in the adjoining bed was weeping. In the intervals between these attacks of laughter her face was apathetic. This appears to be a common symptom in carbon-monoxide poisoning and has been referred to by several observers. Some of these cases show changeable humors, for they rapidly changed from despondency to laughter. Stierlin,[6] in his study on this subject, mentions this lack of emotion. One of his patients evinced this symptom, showing a lack of proper feeling toward his sweetheart, to whom he was engaged before the accident and expected to marry shortly. To some extent this may be explained from the characteristic autopsy results which have been reported in a series of cases where the symmetrical centers of softening were in or about the vicinity of the optic thalmus—most frequently in the globus pallidus and the lenticular nucleus—and hence in those sections of the brain which are supposed to control mimicry.

A subnormal temperature is characteristic of the first stages of the poisoning, after which it rises rapidly, attaining the maximum in the first 12 hours. No record of a subnormal temperature in this case was made. The first temperature, 101° F., was the maximum recorded on the first day following the trauma. On the four subsequent days it fluctuated between this and normal, and from then remained stationary. Ravine[7] cites a case of a high temperature being reported in a child 8 years old which reached 110° F. in 8 hours, accompanied by a pulse rate of 115 per minute. The pulse rate of this patient was in relative proportion to the temperature.

On the physical side we found involuntary evacuation of the bowels and bladder, exaggerated tendon reflexes with clonus, including the Babinski reflex. Disturbances of sensation were also noted, including anasthesias, hyperalgesias, and so forth. The involuntary evacuation of the bowels and bladder existed for about one month in this hospital, and a few days prior to that. This was probably due to the mental confusion and not to the loss of spinal-cord control, for after the confusion disappeared she recovered this control. It is difficult to state whether the neurological disturbances were due to central or peripheral changes in the nervous system. However, the disturbances of sensation, including anasthesias, et cetera, were probably due to the neuritis which always accompanies intoxications of this class.

Opinions differ on the subject with regard to the action of carbon monoxide on the human economy. Haldane has shown by experiments that all symptoms, immediate and secondary, can be referred to the want of oxygen, and that they vary according to the degree of saturation of hemoglobin with the carbon monoxide gas. He states that "with 20 per cent saturation the only symptom is a slight tendency to dizziness and shortness of breath on exertion. As the saturation increases, however, the symptom of want of oxygen becomes more and more pronounced, until at 50 per cent saturation it is scarcely possible to stand, and even slight exertion causes temporary loss of consciousness." In the fatal cases 80 per cent of the hemoglobin is saturated with carbon monoxide. However, Le Desseur sums up his conclusions as follows:

> That in cases of survival oxycarbon intoxication frequently leaves after it a series of complications bearing principally on the nervous system. The paralysis comes from cerebral and medullar lesions, or is due to the polyneuritis, or two other causes may come into play, namely, traumatism and hysteria. The mental troubles are sometimes connected with material alterations in the brain, such as hemorrhages, thromboses, or softenings. Sometimes they are com-

pletely independent. In all these cases the simple anoxhemia—that is, the affinity of the oxide of carbon gas for the hemaglobin of the red corpuscles—is insufficient for explaining all the manifestations. Hysteria itself, though possible in certain cases, is unable to explain the phenomena observed. That experiments would tend to prove that carbon monoxide is dissolved in the serum and has a direct specific localized effect on the nerve cell.

Mott[8] is of the opinion that all the nervous symptoms can be explained by the thrombotic occlusions and hemorrhages which occur as the result of carbon-monoxide poisoning. These hemorrhagic conditions are more noticeable in the white matter of the brain, but this can be explained by the anatomical construction of the blood vessels supplying these parts.

Unfortunately, all observations of the course of such carbon-monoxide psychoses over a period of years is entirely wanting. Sachs, in the preparation of his treatise on this subject, was impressed by this fact and states that "It would be interesting to know the further course of such cases." It is only in a mild uncomplicated case of this sort that we can make any regular comparisons. The majority of these cases prove fatal, and where this not the case the mental symptoms vary from dementia to complete recovery. There are many factors to be considered in the course and prognosis of this disease, namely, the general make-up and predisposition of the patient, the degree of poisoning, and in mine accidents we have to consider, in addition to the intoxication, the emotional stress, the overexertions and deprivations from lack of food, and the exposure accompanying the trauma. Stierlin in his work gives a full report of observations made by himself and others among 21 survivors in the mine catastrophe at Carrieres, on March 10, 1906, which claimed 1,100 victims. These observations are of importance from the fact that they were continued over a period of two and a half years in the natural environments of the patients, where they showed their psychopathological conditions in the eccentricities of their lives, and in their personal relations toward their families and friends. None of these patients made a complete recovery, although some of them were able to earn a living. The chronic effects of the intoxication, however, remained, as was shown by the neurological changes, as well as in the various forms of dementia present. He classified the mental phenomena into four groups, as follows, although none of them could be considered an entity, as each class encroached upon the other: (1) Psychoses caused by carbon-monoxide intoxication; (2) psychoneuroses caused by carbon-monoxide intoxication; (3) emotion psychoses; (4) traumatic neuroses of mixed etiology.

Mott affirms that "considering the effect of carbon-monoxide poisoning being followed by mania, melancholia, confusion, and other mental symptoms, it must not be lost sight of that many cases, to begin with, are suicidal, and therefore if not actually insane at the time, probably possess an insane or neuropathic temperament." This case was a pure and simple intoxication, uncomplicated by any other neurological factor. There was no inherited predisposition, nor was there present any deviation from the normal in the mental state previous to the trauma. The woman gave no evidence of emotional instability, had an even temperament, and was intelligent for one of her class. I am satisfied, from the history given by her aunt, and by one of the servants who had been her friend for a number of years, that the idea of suicide did not enter into her case. She was in an unusually happy mood previous to the poisoning, and, besides this, she was a devout Christian, and always faithful in the performance of her religious duties. While the active mental symptoms abated in March, she was not discharged until one month later, as her physical health was rather poor. Two months afterwards she sailed to her brother's home in Ireland, where she has remained ever since. Inquiries made from her aunt show that the patient has written regularly to her relatives in this country, and that there is no evidence from the content of her letters that she has undergone any change since she left. However, the aunt states that she expects the patient to return to this country within a few months, and she will then have the patient visit the writer.

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[3] Kraepelin: Psychiatry, 8th edition, 1910.

[4] Ueber die Schädigungen des Nervensystems nach Vergiftung mit Kohlenoxyd. Hermann Weidner, Leipzig, 1910.

[5] Ner. & Mental, 1905, XXXII, 332, Abrahamson.

[6] Ueber psycho-neuropathische Folgezustände bei den Ueberlebenden der Katastrophe von Caurriéres am 10 Marz, 1906. Eduard Stierlin, Basel, 1909.

[7] Ravine: The Successful Treatment of a Case of Illuminating Gas Poisoning; Jour. of the A. M. A., June, 1911.

[8] Carbon Monoxide and Nickel Carbonyl Poisoning. F. W. Mott, M. D., F. R. S. Archives of Neurology, London, 1907.

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